MONTHLY WEATHER REVIEW.

Editor: Prof. Cleveland Abbe.

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INTRODUCTION.

The Monthly Weather Review for October, 1903, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph and mail, 166; West Indian Service, cable and mail, 15; River and Flood Service, 52, river and rainfall, 177, rainfall only, 62; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 2962; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Territorial Meteorologist, and Mr. R. C. Lydecker, Acting Territorial Meteorologist, Honolulu, H. I.; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander W. H. H. Southerland, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. Josef Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the Review, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30′, or 10^h 30^m west of Greenwich. The Costa Rican standard of time is that of San José, 0^h 36^m 13^s slower than seventy-fifth meridian time, corresponding to 5^h 36^m west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. Garriott, in charge of Forecast Division.

Stormy weather prevailed over the eastern Atlantic and British Isles from the 1st to the 6th, 11th to the 17, and 20th to the 31st. Over the western Atlantic the weather was quiet from the 1st to the 7th. During the 8th a barometric depression moved eastward over the Atlantic coast of the United States, and during the succeeding three days a storm of great violence occupied the ocean between Bermuda and the American coast. During the 12th and 13th the center of this storm moved northeastward over the Canadian Maritime Provinces. From the 16th to the 18th a disturbance moved from the Gulf of Mexico northeastward over the Atlantic seaboard of the United States. On the 23d a disturbance of moderate intensity appeared over the Bahamas. Increasing in strength this storm moved northward to a position off the North Carolina coast during the 24th, and passed thence northeastward toward Nova Scotia during the 25th, attended by winds that exceeded 50 miles an hour on the North Carolina coast. During the 26th the center of disturbance moved northeastward over Newfoundland. From the 27th until the close of the month the weather of the western Atlantic was dominated by an area of high barometric pressure that remained nearly stationary over the middle-eastern districts of the United States. No important disturbance appeared over the Caribbean Sea.

The first important storm of the month in the United States advanced from the north Pacific to the Atlantic coasts from the 5th to the 8th, attended by general rains in the northern, eastern, and southeastern districts, by high winds on the north Pacific coast and the Great Lakes, and by gales of exceptional severity off the Atlantic coast. During the 8th, when the center of this storm was north of the east end of Lake Superior, a secondary disturbance of great strength developed in the southern end of a trough of low barometric pressure that extended from the Lake region to the middle Atlantic coast. This trough shifted position over eastern New York and New Jersey, and caused torrential rains in the Hudson Valley and New Jersey during the 8th and 9th, and high and increasing winds on the middle Atlantic and southern New England coasts, with maximum reported velocities ranging above 70 miles an hour on the Virginia coast on the 10th. During the northeast movement of the storm center on the 11th and 12th wind velocities of 60 miles an hour were reported on the southeast coast of New England. Storm warnings and advices were issued well in advance of this storm at all points in its course from the Pacific to the Atlantic.

The following comments regarding the work of the Weather Bureau in connection with this storm were made by the American Syren and Shipping, New York, October 17, 1903:

If any certification of the value of the forecast warnings of the Weather Bureau were required, the tributes paid to this service during the past few days by shipowners and shipmasters would be more than sufficient

to establish the practical value of the service rendered to maritime interests. On Wednesday, the 7th instant, the weather conditions from Point Isabel, Tex., to West Quoddy Head, Me., seemed to the average mariner to presage fair weather. But the scientific observers in the Weather Bureau discerned indications of a severe gale which would sweep the Atlantic coast from end to end, and they ordered storm signals set. Several hundred vessels that were ready to put to sea when the warnings came remained in port. Eighteen coastwise steamships and sailing vessels which went forth from harbors regardless of the signals came to grief. Some were battered by heavy seas and others were wrecked on shore. It has been estimated by experts who write on maritime subjects that the United States Weather Bureau since its establishment has saved property to the value of $20,000,000 per annum. The American Geographical Society sets a high value on the practical services of the Weather Bureau, rating it at 2000 per cent annual return on the cost of the yearly maintenance of the system. When the Weather Bureau was established few shipmasters or shipowners recognized its value, and not until hundreds of forecasts of severe gales along the coast were validated by storms did the men who follow the sea begin to repose confidence in the scientific work by the Weather Bureau. A generation ago veteran shipmasters found delight in putting to sea when the storm signals of the Weather Bureau were out. But in time the insurance companies and the shipowners, with minds open to the teachings of science, recognized the value of the weather forecasts and brought about a general respect for the work of the Weather Bureau. Of late years the only flagrant act against the value of the weather forecasts was the positive order by an official of the Portland Steam Packet Company to Captain Blanchard, of the steamboat *City of Portland*, to voyage from Boston to Portland, notwithstanding that the Weather Bureau had set storm signals all along the coast. No other steam or sailing vessel went out of a New England port that night. She was lost with all hands.

The second important storm of the month first appeared on the morning map of the 14th, when pressures were low on the southern Pacific coast and over eastern Kansas. During the 15th and 16th the southern Pacific disturbance moved eastward to the west Gulf district, and the Kansas disturbance northeastward to the Great Lakes. During the 17th the southwestern storm moved northeastward and the Lake storm eastward, and by the evening a trough of low barometer had formed over the Atlantic States with lowest pressure in the middle St. Lawrence Valley. Attending the eastward movement of this trough of low barometer high winds and rain were followed by a decided fall in temperature over the Atlantic seaboard. In connection with this storm warnings were displayed on the west Gulf coast the evening of the 15th, on the middle and east Gulf and south Atlantic coasts and the upper Lake region on the 16th, and on the middle Atlantic and New England coasts and the lower Lake region on the morning of the 17th.

During the 21st and 22d a disturbance of moderate strength advanced from the British Northwest Territories eastward over the upper Lakes and reached the St. Lawrence Valley on the morning of the 23d. From the 23d to the 26th a disturbance moved from the Bahamas northward to the Canadian Maritime Provinces. During the 26th the rapid advance of an area of high barometer from the westward, in conjunction with low barometric pressure off the north Atlantic coast, caused high northwest winds over the Great Lakes.

On the 16th a cool wave overspread the Rocky Mountain districts, and by the morning of the 17th the temperature had fallen below the freezing point in the States of the middle and upper Missouri Valley. During the next two days the cool wave extended east of the Mississippi River attended by frost in the interior of the South Atlantic and Gulf States and by freezing temperatures in the western parts of Virginia and North Carolina and eastern West Virginia. On the 22d and 23d a cool wave advanced from the Northwest over the central valleys and the Lake region, and on the morning of the 24th frost occurred in the interior of the middle and west Gulf States and freezing temperatures in the Ohio Valley. On the mornings of the 25th and 26th frost occurred in the east Gulf and South Atlantic States and extreme northern Florida. Frost again occurred in the Middle and South Atlantic States and the Ohio Valley on the morning of the 28th with freezing temperatures in the southern Appalachian Mountain regions. The frosts of the month in the crop growing districts were announced in the forecasts.

BOSTON FORECAST DISTRICT.

The chief and only unusual feature of the month was the storm which raged with more or less fury from the 8th to 13th, and will pass into history as among the most severe and long-continued disturbances for October on record. The New England coast suffered greatly from its force, beach property being damaged in places, and the coast line terribly scarred by wind and wave. Shipping of all classes remained tied up for four or five days in all New England harbors. The winds, generally easterly, were attended by rain and fog. The northwest gales of the 17th and 18th were very severe on parts of the southern coast, resulting in some loss of life and considerable damage to shipping. Warnings were issued well in advance of the storms and were of great value to shipping and other interests. Excepting the storms mentioned the weather of the month was seasonal and pleasant.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

October was mild and dry. The only features that called for special forecasts were occasional frosts for which timely warnings were issued. The first general frost warning was issued on the 24th and frosts occurred throughout the district almost to the coast.—*I. M. Cline, District Forecaster.*

CHICAGO FORECAST DISTRICT.

There were a few storms only of marked energy in the upper Lake region during the month, although none was exceptionally severe. One storm passed over on the 3d, another on the 6–7th, and still others on the 16–17th, 22d, and 26th. The wreck of the greatest importance during the month was that of the steamer *Erie L. Hackley*, which occurred in Green Bay on the night of the 3d–4th, and resulted in the loss of twelve lives. Warnings had been displayed at Green Bay fully twelve hours in advance of this storm. Warnings were ordered well in advance of all storms except the one on the 26th, which, however, was of short duration, although one steamer and one schooner, both unseaworthy, were wrecked. The weather conditions throughout the forecast district were uneventful, unusually pleasant weather, and moderate temperature prevailing during the greater portion of the month.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

During the first decade several forecasts of frost were sent to portions of Colorado. The special warnings of the morning of the 11th for northern New Mexico and selected points in Colorado marked the close of the season for warnings of this character. There were no cold waves, and the weather throughout the district was in the main fine and seasonable.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

The month was an exceptionally dry one. The rainfall throughout the entire district being small. In fact the month was part of a period of prolonged drought. At San Francisco, for example, from April 16 until October 8, no rainfall amounting to .01 of an inch was recorded on any date. In other words, with the exception of a trace on May 25 and 26, June 11, August 14, and September 28 and 29, there were one hundred and seventy-five days without rain. So long a dry period is not to be found since the Weather Bureau records have been

kept at this office. Referring to some earlier records in my posssssion I find that in 1867 no rain fell between April 13 and September 14, one hundred and fifty-five days. A moderate disturbance on October 9 appeared off the Oregon coast. Southeast storm warnings were displayed from the Farallones, Point Reyes Light, and northward to Eureka. The wind reached a velocity of 60 miles at Point Reyes Light.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.

The last half of the month was unusually dry. Shipping, both inland and along the coast, experienced considerable inconvenience, on account of fog between the 19th and 27th. During foggy weather, at about 4:30 p. m., October 26, the steamship *South Portland*, from Portland, Oreg., bound for San Francisco, ran on the rocks at Blanco Reef, coast of Oregon, and shortly afterwards sank. The passengers and crew numbered 40, 17 of whom were drowned. Storm warnings were issued on the 3d, 5th, 9th, and 31st and advisory messages for smaller disturbances were sent to selected seaports on the 22d, 28th, and 30th. The most severe storm of the month occurred on the 5th, at which time maximum wind velocities of 72 and 80 miles were reported at North Head and Tatoosh Island, respectively. This disturbance was also severely felt east of the Cascade Mountains, in northern Washington, and along the western slope of the Rocky Mountains in Idaho. Heavy frosts were frequent in eastern Oregon, eastern Washington, and Idaho, but as the staple crops matured the previous month, they did no harm. In western Oregon and western Washington several light frosts were reported, but they were not heavy enough to injure vegetation and at the end of the month late corn and root crops were still green and growing.—*E. A. Beals, Forecast Official.*

RIVERS AND FLOODS.

In connection with low area, No. III, over 10 inches of rain fell at New York, N. Y., during the forty-eight hours ending at 8 a. m. of the 10th, and falls almost as heavy occurred over eastern Pennsylvania and New Jersey. The waters of the Delaware, Passaic, Mohawk, and the tidewater section of the Hudson rose with great rapidity and generally attained unprecedented heights. At Albany, N. Y., during the night of the 9th, the water in the Hudson rose at the rate of a foot an hour. The total amount of the property injured and destroyed was appalling, especially in the Delaware and Passaic river valleys. Along the first-named river from below Easton, Pa., to Trenton, N. J., a distance of something over fifty miles, not a single wagon bridge was left standing. Travel and traffic were interrupted or entirely suspended in the flooded regions, and great loss of life narrowly averted at Paterson, N. J. Along the Mohawk and Hudson rivers the destruction of property was great, but was small as compared with that in the other flooded districts, and much loss and damage were obviated by the timely warnings issued by the Weather Bureau official at Albany, N. Y., as may be seen from the following extract from the Albany Press and Knickerbocker:

> The local weather bureau is entitled to considerable credit for its work in connection with the recent flood. On Friday afternoon last the local official noticed that the river was rising, and about 4 o'clock notices were sent out to the merchants along Broadway and other places that at 6 p. m. that day the water would be over the docks, and that by 7 o'clock on Saturday morning a flood stage of about 15 feet would prevail. On Saturday morning at 7:20 o'clock the river was 14.06 feet above mean low water and still rising. A general forecast was sent out that morning stating that the river would begin to fall that evening and that it would continue to go down on Sunday. On Saturday afternoon a special forecast was made and announced that the river would be at its maximum height by 9 o'clock that evening. The river ceased to rise before 8 o'clock and remained at the maximum level until 9 o'clock, when it began to recede and at 8 o'clock on Sunday morning the river was 14.12 feet above the normal and still falling. The local office of the Weather Bureau was open until 9:20 o'clock on Friday evening for the purpose of sending out by telephone messages of warning and answering questions that were asked concerning the rise in the river.

The high water reported in the Mississippi River, above the mouth of the Missouri, during the latter part of the preceding month, passed the flood stage at Hannibal, Mo., on the 4th, inundating the low lands adjacent to that city, and destroying corn and wheat crops valued at $100,000. The maximum stage at Hannibal, 15.8 feet, occurred on the 10th, and exceeded previous October high-water gage records by 4.9 feet. Timely warnings of this flood were issued by the Weather Bureau official at Hannibal. There was but little fluctuation in the waters of the lower Mississippi, a high stage for the season, continuing throughout the month.

The Ohio River was slightly lower than during September, but at no time was navigation interrupted. Changes in the other navigable streams of the country were also of minor importance.

The highest and lowest water, mean stage, and monthly range at 173 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock on the Arkansas; and Shreveport, on the Red.—*George E. Hunt, Chief Clerk, Forecast Division.*

AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	28, a. m.*	35	120	4, p. m.	46	60	4,275	6.5	658	27.4
II	3, p. m.	37	122	7, p. m.	46	60	3,650	4.0	912	38.0
III	6, p. m.	43	124	10, a. m.	49	86	2,450	3.5	700	29.1
IV	9, p. m.	34	118	16, p. m.	46	60	5,000	7.0	714	29.3
V	14, a. m.	48	124	22, p. m.	46	60	4,800	8.5	565	23.5
VI	19, p. m.	48	124	21. p. m.	37	96	1,925	2.0	962	40.1
VII	21, a. m.	47	123	25, p. m.	29	95	2,450	4.5	544	22.7
VIII	25, a. m.	53	108	38. p. m.	38	80	1,800	3.5	514	21.4
Sums							26,350	39.5	5,569	231.5
Mean of 8 paths							3,294		696	29.0
Mean of 39.5 days									667	27.8
Low areas.										
I	30, p. m.*	51	120	6, a. m.	46	60	3,325	5.5	604	25.2
	1, a. m.	39	120				3,675	5.0	735	30.6
II	5, a. m.	53	122	7, p. m.	48	86	1,825	2.5	730	30.4
III	8. p. m.	35	74	14, p. m.	46	60	1,875	6.0	312	13.0
IV	9, a. m.	48	125	18, p. m.	46	60	5,700	9.5	600	25.0
V	15, a. m.	32	107	17. p. m.	35	76	2,000	2.5	800	33.3
VI	18, p. m.	53	107	21, a. m.	46	60	2,300	2.5	920	38.3
VII	20, p. m.	54	114	23, a. m.	48	68	2.275	2.5	910	37.9
VIII	23, a. m.	20	76	26, a. m.	46	60	2,250	3.0	750	31.2
Sums							25,225	39.0	6,361	264.9
Mean of 9 paths							2,803		707	29.5
Mean of 39.0 days									647	27.0

* September.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*George E. Hunt, Chief Clerk Forecast Division.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Divison.

The following summaries relating to the general weather and crop conditions during October are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—Favorable for gathering staple crops, but too dry for late cotton and minor crops; general killing frost on 25th stopped further development of cotton, bulk of which is picked, yield slightly better than anticipated in a few places, but generally below average; all will be gathered by November 15; good yield of corn housed; little oats and wheat sown.—*F. P. Chaffee.*

Arizona.—Over a large part of the Territory no rain whatever fell during the month; rain fell at stations in the northern, central, and western portions early in the month, but the rest of the month was dry. Notwithstanding dry weather the feed on ranges continued good, and cattle were in excellent condition, but the supply of water in wells and streams was diminishing rapidly.—*M. E. Blystone.*

Arkansas.—General heavy to killing frosts on the 24th and 25th. Favorable for gathering crops; too dry generally for fall plowing and seeding, except in northern and middle-western portions. Cotton opened slowly, retarding picking; crop about half picked at close of month; frosts latter part of month caused premature opening. Corn about gathered, early, average yield; late, light. Sweet and Irish potatoes good crops, harvesting general at close of month. Less than usual acreage sown to fall grains owing to insufficient moisture for plowing and germination. Some wheat, oats, and rye up to good stands in northern portion. Stock generally thrifty although there was some complaint of cholera among hogs.—*O. C. Burrows.*

California.—The weather was generally favorable for raisin making, fruit drying, and maturing late grapes and deciduous fruits. Rain during the first part of the month caused but slight damage to raisins, as ample warnings were given, and there was but little injury to beans and other exposed crops. Forest and field fires in southern California caused considerable damage. Unusually heavy fogs were frequent along the coast. The temperature was abnormally high for a few days about the middle of the month.—*Alexander G. McAdie.*

Colorado.—Conditions favored the ripening and harvesting of outstanding crops and fruit, but were too dry for plowing, especially in eastern counties, where seeding made slow and difficult progress; a small acreage of wheat and rye was sown, mostly on unplowed but cultivated or harrowed soils, much of this remaining dormant. The general precipitation at the close of the month no doubt proved favorable to additional seeding and germination. The harvest of sugar beets, potatoes, and winter vegetables made good progress, but about one-half of the beet crop was still in the fields at the end of the month.—*F. H. Brandenburg.*

Florida.—The conditions were favorable for harvesting the last of the cotton crop, but altogether too dry for fall vegetables and seeding for winter truck, except on lowlands where germination was good. Heavy to killing frosts during the last decade were an advantage to citrus fruits. Grinding cane continued; the crop was a fair one. Pineapple slips did well; small shipments were being made. Orange shipments were increasing.—*A. J. Mitchell.*

Georgia.—The weather was favorable for securing late crops, but fall plowing and seeding were delayed owing to the general dryness of the soil. Cotton picking was practically completed at the close of the month, with yield below normal. A destructive frost occurred over the northern section and in portions of the middle and southern counties on the 25th, destroying cotton plants and other growing vegetation.—*J. B. Marbury.*

Idaho.—Weather cloudy and rainy from the 1st to the 6th, inclusive, and on the 9th, 10th, and 11th; on the 12th began a period of bright and pleasant weather, which continued almost without interruption over the entire State till the 27th, after which light precipitation became general on the 28th and 29th, followed by much cooler weather. Late farm work progressed rapidly during most of the month.—*S. M. Blandford.*

Illinois.—The month was warm until the 7th, when a fall below the seasonal average temperature occurred. Another warm period began with the second decade. The coldest periods obtained on the 18th and 24th, when killing frosts occurred in the northern and central districts, respectively. Weather conditions were ideal for farming operations and corn matured beyond expectations. The crop was practically safe before the advent of killing frosts. Early sown wheat was showing well, but late planted needed rain. Pastures were in good condition, except in the southern district.—*William G. Burns.*

Indiana.—Lack of moisture retarded fall plowing and the germination of seed in the south section; conditions were more favorable in the central and north sections, but wheat was small and made slow growth. Corn was practically all safe from injury by frost before the 15th, and the last half of the month being dry, with frequent frosts, the grain dried rapidly. Apples and potatoes were mostly harvested, both crops being light. A heavy crop of tomatoes was saved during the first half of the month.—*W. T. Blythe.*

Iowa.—October was very favorable for maturing belated portion of corn crop and drying it out preparatory for early cribbing. Earliest killing frost occurred on the 18th, and the percentage of soft corn will be but little more than usual. Amount of fall plowing above the average. Conditions were fine for harvesting potatoes, apples, and all late maturing crops. Potato crop generally below average. Vegetables and forage crops extra good. Fall wheat and rye made fine stand.—*John R. Sage.*

Kansas.—Corn matured well with ears well filled; husking began in the northern counties. Wheat about all sown, except in the western counties, where the ground was too dry until the fine rains of the last of the month. Most of the wheat was up; a good stand, looked fine; some was pastured. Abundance of forage was raised and most of it secured in good condition. Pastures were good.—*T. B. Jennings.*

Kentucky.—First of month warm and showery and plowing and seeding progressed rapidly; rest of month dry, retarding germination and growth of wheat. First general killing frost on the 18th. Corn yielded well, considering damage from drought. Tobacco saved in fine condition; yield fair. Pastures badly dried and stock water scarce, but stock generally in good condition. Turnips, late potatoes, and other fall crops generally poor. Winter apples averaged poor, but were good in places.—*S. P. Gresham.*

Louisiana.—Dry weather checked the growth of cotton early in the month and prevented the development of a top crop. Heavy, and in some places killing, frosts from October 24 to 26 completely stopped the growth of the plant and caused matured bolls to open rapidly. As a rule, conditions were exceptionally favorable for picking which was finished or nearing completion at the close of the month except in a few localities. The yield was very light in some localities and was generally below the average. The growth of sugar cane was retarded by dry weather, and as a result a light tonnage was reported. Cool, dry weather favored ripening and a good sugar content was indicated. Rice harvest was finished under favorable conditions. The bulk of the corn crop was housed during the month. Truck gardens suffered from lack of rainfall.—*I. M. Cline.*

Maryland and Delaware.—Considerable damage by frost in extreme west. Corn mostly in shock at the end of month, being still to green to crib; yield light to fair; fodder good. Heavy rains from 8th to 12th, together with lateness of corn crop, delayed seeding of wheat and reduced acreage considerably; early sown looking well; late sown germinated poorly. Fall sown grasses made good stands; pastures were good. Weather quite favorable for farm work.—*Oliver L. Fassig.*

Michigan.—The first decade of October was wet, delaying fieldwork and the maturity of sugar beets and late corn, but the middle and last decades were very favorable. At the close of the month corn was practically all cut and drawn. Sugar beet harvest was well advanced toward the close of the month and fair yields were reported. Winter wheat and rye seeding progressed steadily throughout the month and at its close had been mostly completed; the seed germinated finely.—*C. F. Schneider.*

Minnesota.—Much rain in the early half of the month; dry and clear in the latter half. Light and heavy frosts till the killing frost of the 26th, but hardy plants were still green at the end of the month. Thrashing progressed rapidly late in the month where soft soils in the south did not cause delay. Plowing well advanced, although lowlands were generally too wet to be plowed this season. Winter rye looks well. Very little winter wheat seeded this year because of the wet season.—*T. S. Outram.*

Mississippi.—The weather was very favorable for gathering crops. Killing frost was general on the 25th. Lowland cotton opened very rapidly; in the delta many unmatured bolls were destroyed by frost, but elsewhere the crop was too far advanced to be materially injured; picking progressed rapidly, and by the close of the month was nearly completed on uplands and well advanced on lowlands; the yield continued below the average. Corn gathering was nearly completed, with a good yield. Cane, sorghum, peas, and sweet potatoes were damaged by the drought, but yielded fairly well. Fall crops were generally a failure. No fall plowing was done. Pastures were dry.—*W. S. Belden.*

Missouri.—October was generally favorable for maturing the late corn, and, except in a few counties, where a considerable portion of the crop was very late, comparatively little was injured by frost. Except in some southern counties, wheat sowing was completed, with the soil in excellent condition, and the bulk of the crop was up and growing well at the close of the month. In some southern counties, however, considerable damage by fly was reported.—*A. E. Hackett.*

Montana.—October was notable for its mild, equable temperature, large number of clear days, and small amount of precipitation. Thrashing was completed and good progress was made with fall plowing. Range conditions continued good, and stock did very well.—*Montrose W. Hayes.*

Nebraska.—In most parts of the State the month was very favorable for agricultural interests. Lack of rain in the southwestern counties

retarded the sowing of winter wheat and made germination slow and uneven, but elsewhere wheat came up well and made good growth; the amount sown was slightly less than last year. Corn ripened well, but was late, and husking and cribbing were just beginning at the end of the month. Thrashing progressed rapidly and was about finished. Pastures continued excellent throughout the month.—*G. A. Loveland.*

Nevada.—The month was slightly warmer and much drier than the average October. The weather throughout the month was exceptionally favorable for thrashing grain, baling hay, and harvesting late crops. The condition of live stock was generally satisfactory.—*J. H. Smith.*

New England.—During the second week the weather was stormy with rain, fog, and easterly winds; the remainder of the month was favorable for harvesting and housing crops, fall seeding, and general farm operations. The rainfall was deficient, except in parts of Massachusetts and Connecticut where it was in excess. The minimum temperatures occurred during the closing days of the month, falling to freezing or below in nearly all sections.—*J. W. Smith.*

New Jersey.—Abnormally heavy rains and high winds early in the month did immense damage to late crops and other property, especially in northern portion; harvesting of corn difficult; late planted not fully matured; early sown wheat, rye, and timothy good stand; much yet to sow in southern portion; pastures very good; first killing frost 24th and 25th.—*Edward W. McGann.*

New Mexico.—Almost cloudless weather during the month. Very dry excepting in extreme northeast, and deficiency of previous months made the season unusually dry there also. Ranges short, but stock generally in excellent condition, because the grass cured so well. Surface water becoming quite scarce in some south-central localities.—*R. M. Hardinge.*

New York.—First half of month too wet; latter half more favorable, but freezing weather with snow from 24th to 27th. Wheat and rye sown late, but now in excellent condition for winter. Corn much improved, but poor; most of crop saved without damage from frost. Yield of potatoes better than expected, and mostly dug. Yield of apples larger than estimated, and of excellent quality. Fall plowing not yet finished.—*R. G. Allen.*

North Carolina.—The first half of the month was generally above normal in temperature; the latter half colder, with frequent frosts. In the west the first killing frost occurred generally on the 19th, but was deferred in the central-eastern portion of the State until the 27th. The precipitation occurred in short periods, the long intervals of dry weather being favorable for gathering crops, fall plowing, and seeding of winter wheat and oats, which work made good progress. Picking cotton was completed during the month, and by the date of the first killing frost, about October 27, there was practically no more cotton to be saved; late bolls could not open and were hardly expected to mature. Gathering corn, digging sweet potatoes and peanuts, and housing minor crops were about completed.—*C. F. von Herrmann.*

North Dakota.—Generally mild, pleasant weather prevailed during the month, with temperature high enough to keep the ground from freezing, so that fall plowing was carried on during the entire month. Aside from this, no farm work of consequence was done.—*B. H. Bronson.*

Ohio.—Weather favorable for ripening corn; crop generally good in north, but injured by drought in south. Wheat germinated well in the north, where the crop was quite promising. The continued dry weather seriously affected the crop in central and southern counties. There was some fly reported in the southwest. Tobacco cured well. It was too dry for late gardens and pastures.—*J. Warren Smith.*

Oklahoma and Indian Territories.—Light to heavy frosts caused cotton to open rapidly, but damaged potatoes and bottom-land vegetation. Wheat seeding neared completion; early sown was up to good stand and being pastured in some localities; very backward in western Oklahoma, due to deficient precipitation. Cotton picking progressed with half of crop secured; a half yield promised; cotton damaged by excessive rains in localities in Indian Territory. Corn, Kafir corn, castor beans, sweet and Irish potatoes, cane, millet, and apples were being gathered; fair to good yields. Pastures continued good and stock doing well.—*C. M. Strong.*

Oregon.—During the first decade good rains fell in all parts of the State, but after the 10th dry weather prevailed nearly everywhere. The temperature was seasonable and the frosts that occurred did no harm of consequence. The weather conditions were excellent for seeding, and by the end of the month nearly all the summer fallowed and corn stubble land was seeded with fall wheat or oats. The acreage of fall wheat was much larger than last year and the grain sown early came up nicely, but that sown later was slow in germinating on account of the dry weather and cool nights.—*Edward A. Beals.*

Pennsylvania.—Weather conditions and soil favorable for harvest of late crops, plowing, seeding, and germination; early sown grain up and in excellent condition, but a large acreage was sown late; complaints of soft corn numerous; husking well under way; yield below average; potato crop better than anticipated; apples fair, other fruits scarce; pastures satisfactory; new grass fields well set and making rapid advance; tobacco backward but curing nicely. Killing frost general on the 25th.—*H. A. McNally.*

Porto Rico.—The weather was generally favorable for all crops. The older canes made good progress and were in a very promising condition. Cane planted for gran cultura started unusually well. Planting for this crop was still in progress. Coffee matured rapidly during the last ten days of the month and picking became very active and general. The grain was of good grade. Some rice was harvested; yield poor. A small amount of cotton was marketed. The corn crop is promising, but beans have been seriously injured by heavy showers. Oranges were being shipped to the United States. The markets were well supplied with fruits and vegetables; pastures continued in good condition.—*E. C. Thompson.*

South Carolina.—Favorable for harvesting operations, but generally too dry for the preparation of land and for seeding, although considerable oats and a small amount of wheat were sown. The first general light frost occurred on the 19th, and frosts ranging from light on the coast to killing in the central and western portions followed on the 25th to 29th. Cotton opened freely and picking was practically finished except in west, where considerable late cotton had not reached maturity and some bolls were destroyed by frost. Corn was gathered and haying continued throughout the month. Sweet potatoes yielded well, but other root crops were poor. Fall truck made excellent growth, and shipments were begun.—*J. W. Bauer.*

South Dakota.—Rains in eastern portion during early part of month retarded thrashing and haying, and winds damaged some grain and hay stacks and broke down some corn; rest of month weather very favorable for field operations and outstanding crops. The month closed with considerable thrashing yet unfinished; cribbing of corn well under way, with probably one-fourth of the crop unsound, due to September frost; plowing backward; winter rye in thrifty condition; potato crop nearly secured but yields disappointing.—*S. W. Glenn.*

Tennessee.—Good rains on the 1st, 2d, and 5th to 8th, facilitated plowing and seeding, and were beneficial to unmatured crops and pastures. The rest of the month was generally dry and cooler, with heavy and killing frosts on 18th, 19th, and 25th, which checked further growth. The month was fine for gathering crops. Seeding of grain progressed fairly well in corn land, but elsewhere the dry condition of the soil greatly delayed plowing and seeding; early sown grain was coming up. The month closed with good rains in the eastern section.—*H. C. Bate.*

Texas.—The precipitation of the month was well distributed and sufficient to keep the ground in good condition, and much wheat, oats, and rye were sown. Early sown grain was coming up nicely at the close of the month. Light to heavy frost occurred in the north portion of the State the latter part of the month, but did little or no damage. On the whole conditions were favorable for cotton picking, and but little damage resulted to lint in the fields. Rice harvesting and thrashing were generally completed. Sugar cane matured nicely.—*L. H. Murdoch.*

Utah.—Cold stormy weather prevailed during the first five days of the month when practically the entire monthly precipitation occurred. Cloudless skies with temperatures somewhat above the normal followed until near the close of the month, when a decided change to colder weather took place. Light frosts were frequent, but the first general killing frosts did not occur until the 30th and 31st, much later than usual. Plowing was pushed vigorously to completion and the sowing of winter grain was under rapid headway. In many localities early sown grain was coming up. Beets were being dug with good yields generally reported. Pastures improved and stock was in good condition.—*R. J. Hyatt.*

Virginia.—The work of the month was mainly along the line of fall seeding, and for this the general weather conditions were somewhat too dry. That portion of winter wheat, oats, and clover seeded early did very well throughout the month, coming up evenly and getting a good stand. Fall pastures held up nicely. Frosts damaged late potatoes and corn. Much tobacco was hauled to market.—*Edward A. Evans.*

Washington.—Month free from early and severe frosts. Ample rain in first decade, but remainder of month dry and warm. Some damage to unthrashed wheat and oats in first decade. Weather favorable for plowing and for seeding fall wheat; much seeding done. Wheat that was up was growing nicely. Potatoes and root crops mostly harvested, with good yields. Good apple crop gathered.—*G. N. Salisbury.*

West Virginia.—Plowing progressed rapidly during the second week, and seeding was quickly completed. Wheat, rye, and oats were rather short, but were doing fairly well, considering the dry weather. Pastures were short; feeding will begin earlier than usual, but stock continued in good condition. Corn husking was in progress, and about a half crop will be secured. A killing frost was general on the 25th. Apples were all picked; a good crop gathered in the panhandle section and a fair crop in some southern counties.—*E. C. Vose.*

Wisconsin.—A tornado passed through the southern portion of Portage County on the 3d, doing considerable damage to orchards, buildings, and crops in the field. Severe local storms were general over the central counties on that date. With the exception of showers from the 15th to 17th, fair and very pleasant weather prevailed during the second and third decades. Winter wheat and rye made good progress and were in satisfactory condition.—*W. M. Wilson.*

Wyoming.—An unusually severe windstorm prevailed over the State on the 6th, doing some local damage. On the 29th and 30th a snowstorm was quite general over the State, but the snowfall was not heavy. As a whole, the weather conditions of the month were very favorable for outdoor work and for all stock.—*W. S. Palmer.*

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Summary of temperature and precipitation by sections, October, 1903.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	63.4	−0.6	Hamilton Florence, Talladega	97 97	2 3	Valleyhead	22	25	1.82	−0.66	Cordova	4.36	Greenville, Ozark	0.50
Arizona	64.2	−1.0	Aztec Parker	103 103	1 17	Flagstaff	14	31	0.06	−0.61	Flagstaff	1.04	41 stations	0.00
Arkansas	60.9	−1.3	Texarkana	97	2	Rison Brinkley	26 26	24 25	2.21	−0.40	Wiggs	4.87	Helena, No. 1	0.24
California	64.0	+2.8	Elsinore	109	18	Bodie	6	20, 26	0.49	−0.89	Upper Mattole	7.84	56 stations	0.00
Colorado	48.2	+1.2	Blaine	94	10	Westcliffe	−4	31	0.90	−0.23	Boulder	3.43	Grover, San Luis	0.00
Florida	70.8	−1.4	Brooksville Rockwell	93 93	6 1, 12	Sumner	29	25	1.82	−2.66	Wewahitchka	6.58	Fort Pierce	0.00
Georgia	63.2	−0.7	Albany	95	7	Clayton, Diamond	25	28	2.06	−0.75	Greenbush	4.85	Griffin	0.44
Idaho	49.1	....	Blue lakes Garnet	86 86	18 10	Chesterfield	7	31	1.20	....	Murray	2.54	American Falls	0.19
Illinois	53.8	+0.6	Benton, Cisne	91	3	Lanark	16	27	2.46	+0.04	Aledo	5.09	Antioch	0.80
Indiana	55.0	+0.4	Rome	95	3	Northfield, Richmond	18	27	2.68	+0.36	Washington	5.21	Topeka	0.59
Iowa	52.2	+0.3	Chariton	90	3	Earlham	16	27	1.95	−0.49	Harlan	4.50	St. Charles	0.32
Kansas	57.2	+0.5	Hoxie Eureka Ranch	93 93	2 19	Achilles	17	26	3.63	+1.15	Burlington	8.02	Achilles	0.16
Kentucky	57.7	−0.5	Beaver Dam	96	3	Loretto	19	28	2.22	+0.22	Alpha	4.65	Cadiz	0.95
Louisiana	66.1	−1.3	Oxford	95	3	Collinston	27	25	1.63	−1.10	Abbeville	4.68	Ruston	T.
Maryland and Delaware	56.7	+1.0	Charlotte Hall, Md.	89	5	Oakland, Md	20	25, 31	4.19	+1.13	Pocomoke City, Md	9.63	Westernport, Md	1.58
Michigan	49.7	+1.4	South Haven	90	3	Baldwin	13	27	2.17	−0.52	Mackinac Island	5.88	Lake City	0.10
Minnesota	46.1	−1.5	Lynd (Rouse)	81	19	Floodwood	12	27	3.13	+1.00	Pine River Dam	5.98	Albert Lea	1.45
Mississippi	64.2	−0.1	Lake Como	98	1, 2, 4	Tupelo	22	25	1.12	−0.93	Walnut Grove	3.38	Okolona, Patmos	0.07
Missouri	57.3	+0.3	Marblehill, St. Charles.	90	3	Louisiana	19	27	2.85	+0.40	Ironton	6.38	Fairport, Princeton	1.11
Montana	47.6	+3.2	Billings	85	20	Wolsey	11	30	0.47	−0.49	Marysville	1.47	Twin Bridges	0
Nebraska	53.4	+2.2	Bartley, North Loup Lynch	93 93	2 18	Agate	12	31	1.25	−0.24	Wakefield	3.93	Lodgepole	T.
Nevada	51.0	+3.0	Wabuska	90	24	Potts	11	29	0.29	−0.22	Morey	1.60	6 stations	0.00
New England*	50.1	−2.0	Hyannis, Mass. Grove Beach, Norwalk and Waterbury, Conn.	79 79	3 2	Morrisville, Vt	10	27	3.63	−0.01	Cream Hill, Conn	6.39	Turners Falls, Mass.	1.69
New Jersey	55.9	+1.1	Salem	86	2	Layton	24	25	8.92	+5.21	Paterson	16.19	Toms River	4.17
New Mexico	53.4	−0.3	Carlsbad	99	10	Winsors	12	21	0.13	−0.95	Eagle Rock Ranch	1.87	18 stations	0.00
New York	50.4	+1.4	Cutchogue Appleton	80 80	2 7	Paul Smiths	2	28	5.89	+2.87	Salisbury Mills	14.63	Akron	1.46
North Carolina	59.0	−0.8	Tarboro	91	5	Linville	14	29	3.59	−0.02	Currituck Inlet	7.98	Mountairy	0.54
North Dakota	47.0	+4.0	Fort Yates Jamestown	81 81	10 11	Fargo	11	26	0.94	+0.02	Larimore	2.50	2 stations	T.
Ohio	54.0	+0.6	Hanging Rock	93	4	Coalton	15	27	2.62	+0.46	Pomeroy	5.47	Napoleon	1.11
Oklahoma and Indian Territories.	61.2	−1.1	Hennessey, Okla Eldorado, Okla Mangum, Okla	95 95 95	8 6 3, 4, 6	Pawhuska	24	23	3.03	+0.42	Hartshorne, Ind. T.	9.05	Marlow, Ind. T	0.20
Oregon	52.7	+1.2	Coyote	93	6	Beulah, Vale	14	30	2.45	−0.67	Glenora	12.18	Coyote	0.30
Pennsylvania	53.4	+2.2	California	91	4	Dushore	20	25	4.64	+1.24	Milford	10.53	Beaver Dam	2.07
Porto Rico	78.3	....	Manati	97	12	Barros	52	8	8.20	....	La Carmalita b	16.30	Coamo	3.30
South Carolina	62.0	−1.2	Anderson	93	2	Clemson College	25	25	2.63	−0.25	Darlington	4.68	Calhoun Falls	0.86
South Dakota	51.5	+3.7	Rosebud	98	23	Grand River School	10	28, 31	1.16	−0.04	Elk Point	3.90	Rosebud	0.15
Tennessee	58.7	0.0	Liberty	97	3	Hohenwald Rugby	16 16	25 28	1.82	−0.71	Yukon	4.32	Memphis	0.25
Texas	65.5	−2.3	Cotulla	100	2	Colorado, Menardville.	27	24	2.45	+0.11	Runge	7.32	2 stations	0.00
Utah	50.3	+1.3	Green River	97	6	Ibapah	6	31	0.89	+0.13	Morgan	2.72	3 stations	0.00
Virginia	56.9	−0.4	Newport News	90	6	Burkes Garden	13	28	3.52	+0.16	Hampton	7.49	McDowell	0.65
Washington	50.8	+0.9	Pomeroy	84	18	Wilbur	20	30	2.11	−0.35	Clearwater	10.95	Trinidad	0.00
West Virginia	54.2	+0.5	Charleston	96	4	Cairo	15	27	2.55	+0.53	Terra Alta	4.73	Webster Springs	0.80
Wisconsin	48.2	+0.3	Brodhead, Racine Appleton Marsh	82 82	3 15	Easton, Spooner	17	27	2.40	−0.14	Hayward	4.95	Hillsboro	0.82
Wyoming	45.7	+2.2	Phillips Tensleep	83 83	9 10	South Pass City	8	31	0.74	−0.24	Bedford	2.27	Lusk	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

SPECIAL CONTRIBUTIONS.

SOLAR RADIATION AND EARTH TEMPERATURES.

By C. G. KNOTT, Professor, University of Edinburgh, dated January, 1901. Reprinted from the Proceedings of the Royal Society of Edinburgh, Vol. XXIII, pp. 296-311.

At a recent meeting of the Society, Doctor Buchan read a paper based on certain observations of the temperature of the waters of the Mediterranean, which had been made by the staff of the Austrian ship *Pola*. These indicated that the direct effect of solar radiation was felt to a depth of over 150 feet. At any rate, the facts were that the temperature of the upper stratum of water of this thickness was perceptibly higher at about 4 p. m. than at 8 a. m., and that the difference was about 1.5° F., or 0.8° C., at the surface, diminishing fairly steadily to value zero at a depth of fully 150 feet, or 50 meters. It may easily be calculated that this excess of temperature at the afternoon hour means the accumulation of an amount of heat equal to 1460 units in every column of water 1 square centimeter in section; and this is accomplished within the eight hours from 8 a. m. to 4 p. m. It must be noted that this accumulation of heat is a daily occurrence.

The whole process of the heating and cooling of any portion of the earth's surface is a very complicated one. Doubtless there is constant radiation into space going on steadily day and night. During the day the solar energy enters the atmosphere and part of it reaches the earth's surface, heating the matter

there. At night this direct heating effect is absent. There must, therefore, result a steady periodic state of temperature change, a daily seesaw, as much on the average being lost every night as is gained every day. This daily fluctuation is of course subject to a seasonal variation, depending primarily on the declination of the sun, but also, as Langley has shown, on atmospheric conditions, the true nature of which is at present a matter of speculation. But whatever these conditions may be, and whatever may be the real physical process by which the seesaw of temperature is produced in the Mediterranean waters, we must regard this resultant accumulation of heat during the day as due to solar radiation, direct and indirect. And the first question which demands an answer is, what fraction of the whole heat supplied by the sun is represented by this quantity which gets stored up in the surface waters of the Mediterranean? Making a rough calculation, I found that this stored-up heat was more than could be reasonably accounted for if we accept Langley's estimate of the solar constant. According to Langley's measurements, the solar energy which flows every minute normally across a square centimeter of the earth's surface, after a portion has been absorbed by a clear atmosphere, is about 2 calories. In other words, if a cubic centimeter of water were set with one face pointing to the sun, and if the solar energy crossing that face were all transformed into heat within the cubic centimeter of water, the temperature of the water would be raised 1° C. in one minute. Hence, an accumulation of 1460 calories under each square centimeter of the surface means that with a steady vertical sun, and with no loss in other directions, the sun would require to shine for 590 minutes, or nearly six hours. But six hours of a vertical sun is an impossibility, and it is certain that the solar radiation incident upon the face of the waters is not wholly transformed into heat within the water. A definite fraction is reflected, and a definite amount must always be passing out by convection, radiation, emission, and other processes. Taking all these conditions into account, we have great difficulty in believing that, between the morning and afternoon of each day, heat to the amount of 1460 units can be accumulated in the surface waters of the sea, unless we can discover some other source of heat than the direct radiation of the sun.

To make the comparison more complete, I have made a detailed calculation of the amount of solar heat supplied to each square centimeter of the earth's surface in the latitude of the Mediterranean, the calculation being based on Langley's broad results. To make an accurate calculation is at present an impossibility, for the necessary data are not yet to hand. Langley has shown indisputably that selective absorption in the atmosphere makes it impossible to treat the absorptive action of the air as a whole. That is to say, if the radiant energy of the sun is reduced from E to aE after transmission through a given mass of air, we can not assume that it will be reduced to $a^n E$ after transmission through n times the given mass of air. The assumption may reasonably enough be made for each individual ray; but, since the coefficient of transmission varies greatly with the wave length and according to a law which experiment alone can discover, the use of a mean value of a for the whole radiation will necessarily give too great a value for the transmissibility through increasing masses of air. Bearing this in mind, we may for the present purpose assume the law mentioned, although we know that it is only a first rough approximation and will give too high a value for the transmissibility when the altitude of the sun is small.

Langley's broad result is that the energy of the solar radiation, which reaches the earth's surface after transmission through the vertical depth of atmosphere, is about two-thirds of the energy which would reach the surface if the air were absent. Calling this coefficient of transmission a we see that if ζ represents the zenith distance of the sun, the mass of air traversed is roughly proportional to sec ζ. The radiation falling normally on unit surface is therefore proportional to $a^{\sec \zeta}$. Hence, the radiation falling on each square centimeter of the earth's horizontal surface is proportional to $\cos \zeta . a^{\sec \zeta}$. If we multiply this by the element of time and integrate from sunrise to culmination, we shall get half the quantity of solar energy which falls on each square centimeter of the earth's surface during one day. Let λ be the latitude of the place and δ the sun's declination at the time considered, then the zenith distance ζ is connected with the time by means of the formula

$$\cos \zeta = \sin \lambda \sin \delta + \cos \lambda \cos \delta \cos \omega t$$

where ω is the angular velocity of the earth about its axis.

The evaluation of the integral

$$\int \cos \zeta \; a^{\sec \zeta} \, dt$$

can be effected with sufficient accuracy by graphical methods. To this end the quantity $\cos \zeta \; a^{\sec \zeta}$ was calculated for a series of convenient values of ζ and then, by means of the formula given above, the corresponding values of t were calculated for the positions of the sun at intervals of a month, ranging from summer to winter solstice. For each value of the sun's declination a curve was then drawn, the abscissas of which were the times reckoned from culmination, and the ordinates the corresponding values of the relative solar radiation falling on unit horizontal surface, the unit radiation being the quantity that would have fallen normally on a square centimeter had there been no atmospheric absorption. The data from which these curves are constructed are given in Table 1.

TABLE 1.—*Showing the time in hours, reckoned from culmination, at which for given values of the sun's declination, as shown in the top row, the radiation crossing unit horizontal surface in latitude 33° north has the value shown in the first column.*

R.* (Relative.)	Declination of the sun.						
	+23° 27′	+20°	+12°	0°	−12°	−20°	−23° 27′
	Hour.	*Hour.*	*Hour.*	*Hour.*	*Hour.*	*Hour.*	*Hour.*
0.703	0.00						
0.675		0.00					
0.638			0.00				
0.606	1.83	1.67	1.11				
0.549				0.00			
0.512	2.71			1.17			
0.427					0.00		
0.333						0.00	
0.331	4.00	3.88	3.57	2.82	1.96		
0.302							0.00
0.245	4.53						1.46
0.0914	5.51	5.44	5.11	4.60	3.98	3.49	3.21
0.0600	5.82						
0.0073	6.44	6.28	5.94	5.43	4.86	4.44	4.24
0.0000	7.06	6.89	6.53	6.00	5.47	5.08	4.90

* The unit is a rate of 1 calorie per minute.

From these seven curves we can estimate the areas and thus evaluate the integral $\int R dt$ from culmination to sunset or from sunrise to culmination. The results are given in Table 2, in which the first column contains the sun's declination, and the second the relative radiation reaching unit horizontal surface [at latitude 33° north], the unit of time involved being the minute.

TABLE 2.—*Total insolation at latitude 33° north.*

Declination.		Half-daily heating (relative).*
°	′	°
+23	27	158.34
+20		150.57
+12		135.00
0		105.15
−12		73.8
−20		54.0
−23	27	46.8

* The unit is a rate of 1 calorie per minute.

These numbers are shown graphically as curve No. 5 for latitude 33° north).

Multiplying the numbers in the second column of Table 2 by twice the value of the solar constant, we get, in absolute units, the amount of heat supplied daily by the sun to unit area of the earth's horizontal surface. According to Langley's elaborate researches the value of the solar constant may be taken as 3 calories per square centimeter per minute. Hence, multiplying by 6 we find that there fall on each square centimeter of the earth's surface, in the latitude of the Mediterranean, 950 units of heat[1] during the midsummer day.

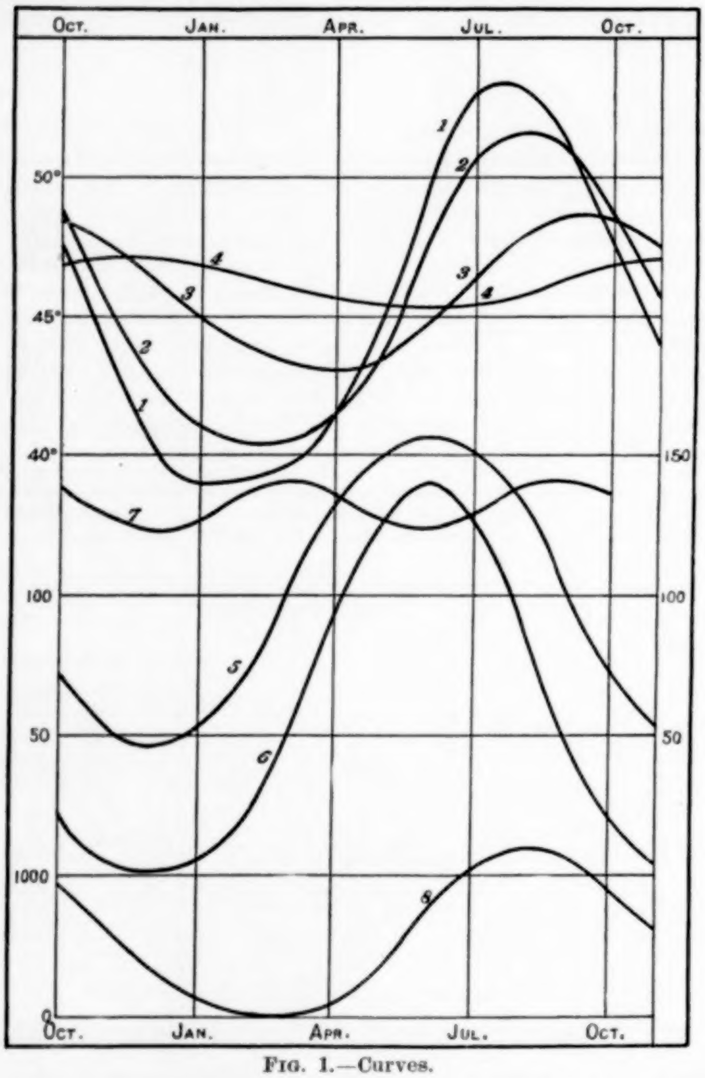

FIG. 1.—Curves.

To compare with the data furnished by the *Pola* observations, which were made during the months of July, August, and September, we should, however, take, not the midsummer value, but the average value during these months. This average is less than 850 units per day. But, further, the temperature observations were made in the morning and the afternoon, say, at 8 a. m. and 4 p. m., an interval of only eight hours. Evaluating the areas of the curves through an interval of four hours from culmination instead of through the half day, we get in place of the first four numbers in Table 2 the values 136, 131, 120, 97. The mean of these is 121, giving a total supply during the eight hottest hours of the day of only 730 units of heat to each square centimeter of surface.

Let us now consider the data which Dr. Buchan has extracted from the *Pola* observations. They are contained in Table 3, in which the first row gives the depths in meters, and the second the excess, in Fahrenheit degrees, of the afternoon temperature over the morning temperature.

[1] This unit is the rate of 1 calorie per minute.

TABLE 3.

Depth in meters	0	1	2	5	11	20	30	50	75
Temperature difference, Fahrenheit degrees	1.5	1.4	1.3	1.3	0.9	0.5	0.3	−0.1	0

Constructing with these a curve, and estimating the area contained within the curve and the coordinate axes, we find, on reducing to centigrade degrees, that the afternoon excess of temperature means an accumulation during the eight hours of 1460 units of heat under each square centimeter of surface. And yet direct pyrheliometric measurements give us only 730 units of heat in the same time. We know, moreover, that all the incident solar energy can not be absorbed by the water, but that a considerable fraction is reflected or escapes in other ways. It therefore seems impossible to explain the afternoon temperature excess down to these depths in the Mediterranean as a result of direct solar radiation. The only way out of the difficulty is to suppose that there is some considerable error in one or the other of the sets of experimentally ascertained facts on which the present discussion is based. To make the facts compatible we should have either to diminish by at least one-half the temperature differences observed by the officers and crew of the *Pola*, or greatly to increase the value of the solar constant. I do not think that the broad results obtained by Langley can be seriously called in question, or that there is any ground for believing that the true value of the solar constant can be much greater than the value, three, estimated by him.

A careful study of Langley's measurements and reductions leaves on the mind little doubt as to the main accuracy of his conclusions, which differ from the conclusions of previous investigators by assigning a somewhat greater value to the solar constant. A very careful scrutiny of the conditions under which the *Pola* observations were obtained and the methods employed, supplemented by similar series of observations carried out in wide oceans, might determine how far the results were affected by purely local conditions. At present it seems to be impossible to suggest any satisfactory explanation of the extraordinary magnitude of the depth to which the daily solar radiation apparently penetrates in the Mediterranean Sea.

It has been long known that the solar radiation penetrates to a comparatively small depth in the rocky material of the earth. In 1837 Professor Forbes began a valuable series of observations of temperature at various depths in the rock of the Calton Hill, Edinburgh, and the main conclusions from these may be found in several of our modern text-books (e. g. "Tait's Heat"). Thus, the conductivity of the rock is easily calculated by methods furnished by Fourier is his classical work "Théorie de la Chaleur" (1822). From this, in combination with the observed rate of increase of temperature with depth, an estimate may be made as to the amount of heat lost by the earth every year. This is perhaps the most interesting of all results deducible from measurements of earth temperature.

There is, however, another direction of inquiry suggested by the comparison made in the early part of the present paper, and that is to estimate the accumulation of heat at different times of the year throughout the rocky stratum. When this is done a comparison may then be made between the heat so accumulated and the available quantity of energy according to Langley's estimate. Thus, we should expect to find that during a particular month of the year there was more heat accumulated in the rocky stratum than during any other month. This will be due to the excess of radiation supplied in the summer months. The relation between these two quantities may possibly lead to an approximate measurement of the emissive power of the earth.

In the calculations which follow I have used as fundamental

data the earth temperatures at Edinburgh during the eight years beginning October, 1879. These were published by Piazzi Smyth (Transactions of the Royal Society of Edinburgh, Vol. XXXV), and were discussed by him in connection with sun-spot periodicity. There are four thermometers in all, distinguished as Nos. 1, 2, 3, and 4, their depths being, respectively, 0.8763, 1.4478, 3.238, and 6.35 meters. In Table 4 the mean of the eight monthly means for each thermometer is given for every month throughout the yearly period.

TABLE 4.—*Eight-year means of earth temperatures.*

Months. October, 1879–September, 1887.	Thermometers. No. 1.	Thermometers. No. 2.	Thermometers. No. 3.	Thermometers. No. 4.	Calculated surface temperature.
	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*
October	46.445	48.748	48.52	46.863	45.06
November	43.785	45.558	47.655	47.136	39.30
December	40.284	42.611	46.345	47.146	36.32
January	39.859	41.069	44.983	46.908	36.08
February	39.28	40.515	43.983	46.521	37.46
March	39.661	40.616	43.414	46.104	39.78
April	41.641	41.628	43.181	45.728	43.30
May	45.108	44.055	43.646	45.450	48.22
June	49.993	47.926	44.863	45.36	53.56
July	52.995	50.78	46.498	45.533	57.00
August	53.12	51.588	47.873	45.896	56.46
September	51.48	51.08	48.693	46.443	51.78

The main features embodied in these numbers are indicated in the corresponding curves Nos. 1, 2, 3, and 4. The well-known manner in which the crest of the temperature wave lags behind as the depth increases is evident at a glance, as also the rapidly diminishing range of temperature.

Each set of numbers was then treated by harmonic analysis in accordance with the formula

$$\begin{aligned} v = A_0 &+ A_1 \cos\ \theta + B_1 \sin\ \theta \\ &+ A_2 \cos 2\theta + B_2 \sin 2\theta \\ &+ A_3 \cos 3\theta + B_3 \sin 3\theta \\ &+ A_4 \cos 4\theta + B_4 \sin 4\theta \\ &+ A_5 \cos 5\theta + B_5 \sin 5\theta \\ &+ A_6 \cos 6\theta + B_6 \sin 6\theta \end{aligned}$$

where v is the temperature, and the A's and B's are constants to be determined by calculation from the twelve linear equations when for each value of the temperature given to v the corresponding value of θ is inserted in the expressions on the right. Beginning with the value $\theta = 30°$ for October, θ increases by 30° in each succeeding month. The constants are tabulated in Table 5.

TABLE 5.

	Thermometers. No. 1.	Thermometers. No. 2.	Thermometers. No. 3.	Thermometers. No. 4.
	°*F.*	°*F.*	°*F.*	°*F.*
A_0	45.358	45.518	45.8045	46.257
A_1	+ 5.899	+ 5.304	+ 2.672	+ 0.156
B_1	− 4.447	− 2.400	+ 0.728	+ 0.886
A_2	+ 0.21	+ 0.278	+ 0.2145	+ 0.0053
B_2	− 0.8983	− 0.572	− 0.048	+ 0.0462
A_3	− 0.1157	− 0.125	− 0.0408	+ 0.0047
B_3	+ 0.3373	+ 0.227	− 0.0055	+ 0.0107
A_4	− 0.0045	+ 0.0435	+ 0.0238	+ 0.0057
B_4	+ 0.043	+ 0.0738	+ 0.0033	+ 0.0042
A_5	+ 0.1267	+ 0.0558	+ 0.0082	+ 0.009
B_5	− 0.0872	− 0.0305	+ 0.0073	+ 0.0028
A_6	+ 0.0123	+ 0.017	+ 0.0207	+ 0.010
B_6	0	0	0	0

Most information is obtained from the first and second harmonic terms in each. According to the recognized theory, it should be possible to combine the first harmonic terms in the formula

$$v = V\varepsilon^{-p'x} \cos\left(\frac{2\pi}{T}\,t - px + q\right)$$

where V is the amplitude at the surface ($x=0$) and p', p, q are constants, of which p and p' should have the same value. The constant p' is calculated at once by taking the ratio of any two of the amplitudes, and dividing the Naperian logarithm of this ratio by the difference of depth of the corresponding thermometers. The three values of p' found in this way by combining the 1st and 2d, the 2d and 3d, and the 3d and 4th are 0.00436, 0.00386, and 0.00363, giving a mean of 0.00392.

Then p may be calculated from the phases when the expression $A \cos\theta + B \sin\theta$ is thrown into the form $P \cos(\theta + Q)$; for this quantity Q must be equal to $-px + q$. We have four equations to determine two quantities. Working them out by the method of least squares, we find

$$p = 0.00371 \qquad q = 0.9629.$$

The difference between these values for p and p' is not more than what might reasonably be expected.

Finally, calculating the value of V from each set, we get the four values 10.34, 10.35, 10.03, and 11.2, a very satisfactory result giving a mean of 10.48.

Hence, we may write the most important term representing the annual wave of temperature passing downward into the rock of the Calton Hill in the form

$$v = 10.48\,\varepsilon^{-0.00392x} \cos\left(\frac{2\pi}{T}\,t - 0.00371\,x + 0.963\right).$$

This gives a wave length of about 16.93 meters, but before this depth is reached the amplitude of the variation has become too small to be appreciable.

In the expression just given x is measured in centimeters. If, then, we integrate it with regard to dx from x equal to zero to x equal to infinity, and multiply the result by the thermal capacity of unit volume of the rock, we shall obtain an estimate of the quantity of heat which, at a given instant, is contained in the rock per square centimeter of surface. The value is

$$\frac{cV}{p'^2 + p^2}\left\{ p' \cos\left(\frac{2\pi t}{T} + q\right) + p \sin\left(\frac{2\pi t}{T} + q\right) \right\}$$

where c is the thermal capacity per unit volume.

The greatest positive value of this is when

$$\frac{2\pi t}{T} + q = \frac{\pi}{4}$$

and the least positive value, or greatest negative value, is when

$$\frac{2\pi t}{T} + q = \frac{5\pi}{4} \text{ or } -\frac{3\pi}{4}.$$

The times corresponding to these values are −0.0307 and +0.4693 expressed in fraction of a year and reckoning from the middle of September, that is, about the beginning of September and the beginning of March.

Hence, there is more heat accumulated within the Calton Hill rock in the month of September than in the month of March by an amount equal to—

$$\begin{aligned} \frac{1}{\sqrt{2}} \cdot \frac{2cV(p' + p)}{p'^2 + p^2} &= \frac{cV\sqrt{2}}{p} \\ &= 2000\ °\text{F., nearly.} \\ &= 1111\ °\text{C.} \end{aligned}$$

A better estimate may, however, be made from the temperature observations themselves if we first of all calculate the values at the surface. This requires us to work out the successive harmonics in the same way in which the first has been treated. The results for the second harmonic are as follows. The aim being to express the four harmonic terms in the form—

$$V\varepsilon^{-q'x} \cos\left(\frac{4\pi}{T}\,t - qx + e\right)$$

the three values obtained for q' were 0.00659, 0.00592, 0.00497, and the values of q and e worked out from the four-phase relations by the method of least squares were 0.00515

and 1.84. These give 1.656 as the mean value of the amplitude of the temperature variation at the surface.

The comparative smallness of the amplitudes of the third and fourth harmonics, and the shortness of the period of the fifth harmonic, render it quite unnecessary for these to be taken into account. The two harmonic expressions for the surface variation, obtained from the general expressions by putting x equal to zero, may then be taken as representing fairly well the variation of temperature at the surface. The combined expression is—

$$v = 10.48\, \varepsilon^{-0\cdot00397x} \cos\left(\frac{2\pi}{T}t - 0.00371x + 0.963\right)$$
$$+ 1.656\, \varepsilon^{-0\cdot00583x} \cos\left(\frac{4\pi}{T}t - 0.00515x + 1.925\right).$$

Calculating the numerical values at the surface ($x = 0$) for the successive months, we get a set of temperatures which may conveniently be tabulated along with the means of the observed temperatures at the different depths. We are now furnished with five columns of numbers, each row containing the simultaneous temperatures at the surface and at the positions occupied by the thermometers. The calculated values of the surface temperatures are given in the last column of Table 4. We may now get fairly accurate determinations of the accumulated heat within the crust at any time by multiplying the mean of the temperatures at each pair of consecutive positions as we descend by the distance between the corresponding positions measured in centimeters. The four quantities so obtained are then added together, and the result multiplied by the thermal capacity per unit volume. Reducing to the centigrade as unit, and subtracting the smallest of the numbers from all the others, we finally obtain a series of numbers representing the annual gain and loss of heat under each square centimeter of the earth's surface. In this calculation we neglect the heat which penetrates below the deepest thermometer. This, however, is comparatively small, and besides, the determination of the surface temperatures will almost certainly involve as large errors. The final results are shown graphically in curve No. 5, and are given in Table 6, which contains, in addition to the monthly values deduced from the temperatures as originally tabulated, intermediate values obtained by calculation from the interpolated values taken from the curves.

TABLE 6.

Month.	Accumulation of heat per square centimeter of surface.	Month.	Accumulation of heat per square centimeter of surface.
October	910 754	April	87 245
November	604 452	May	330 520
December	296 183	June	719 909
January	107 55	July	1,041 1,128
February	18 3	August	1,189 1,212
March	0 27	September	1,161 1,045

From these numbers we learn that in the beginning of September there are some 1200 more units of heat under each square centimeter of the Calton Hill than in the beginning of March.

It remains now to compare this accumulation of heat with the amount of energy supplied by solar radiation. To this end we must make for the latitude of Edinburgh the same kind of calculation as was made for the latitude of the Mediterranean in the first part of this paper. The results are given in Table 7 drawn up similarly to Table 1.

TABLE 7.—*Showing the time in hours, reckoned from culmination, at which for given values of the sun's declination, as shown in the top row, the radiation crossing unit horizontal surface in latitude 56° north has value as shown in the first column.*

R.	Declination of the sun.						
	+23° 27′	+20°	+12°	0°	−12°	−20°	−23° 27′
	Hour.	*Hour.*	*Hour.*	*Hour.*	*Hour.*	*Hour.*	*Hour.*
0.552	0.						
0.516		0.					
0.512	1.57	0.81					
0.433			0.				
0.421	2.92	2.43					
0.331	3.89	3.48	2.49				
0.296				0.			
0.245	4.7	4.34	3.51	1.77			
0.145					0.		
0.0914					2.03		
0.060	6.6	6.2	5.41	4.22	2.63		
0.0554						0.	
0.051							0.
0.0073	7.54	7.11	6.27	5.13	3.83	2.61	2.54
0.0000	8.66	8.11	7.18	6.00	4.78	3.82	3.79

From the graphical representations of these seven sets of numbers we can estimate the areas and so evaluate the integral $\int Rdt$ through half a day. With the minute as the unit of time involved, we find the numbers in the second column of Table 8 expressing the relative radiations during half a day for the different declinations of the sun, the unit being the amount that would cross unit area perpendicularly in one minute were there no absorption in the atmosphere. [These numbers give the curve No. 6.]

TABLE 8.—*Total insolation at latitude 56° north.*

Declination.	Half-daily heating (relative).	Daily heating (absolute).
° ′		*Calories.*
+23 27	141.2	847.2
+20	125.4	752.4
+12	95.5	573.
0	51.8	310.8
−12	20.7	124.2
−20	5.48	32.9
−23 27	5.06	30.4

Multiplying the numbers in the second column by twice the solar constant, namely 6, we get the daily heating expressed in calories. The values are given in the third column.

The particular values of the declination entered in the first column are the values at equal intervals of a month.[2] With these as abscissas, and with the corresponding values of the energy supplied per day, we may construct a curve showing the manner in which the heating effect varies from day to day throughout the year. This curve is given as No. 6 of fig. 1. From this curve by estimation of areas we can readily calculate the whole amount of radiant energy supplied by the sun during any assigned period of time. Thus, we find:

Energy supplied during summer months, 114,840 calories.

Energy supplied during winter months, 19,080 calories.

Roughly speaking, the sun supplies during the summer months in our latitudes nearly 100,000 units of energy per unit area in excess of what it supplies during the winter months. But of this amount only 1200 units accumulate in the crust in the form of heat. In other words, only about 1 per cent of the energy falling on the surface of the earth is allowed to accumulate in the crust of the earth as heat. The remaining 99 per cent escapes by radiation and convection or is partly reflected back untransformed into heat. This seems to be quite a reasonable result, and contrasts markedly with the extraordinary result given in the first part of this paper.

The above estimate is necessarily of a rough character. In this country [Scotland] the sunshine which reaches the earth's

[2] That is, from June 20 or 21 to December 20 or 21.

surface so as to be propagated downwards as a wave of heat is, on the average, much less than would be in a clear atmosphere similar to that in which Langley worked. Consequently the overplus of energy supplied in the warmer months of the year is probably overestimated. Then, again, there is some doubt as to the surface values of temperature as deduced from the Calton Hill thermometers, for a complete account of which I refer to a paper shortly to be published in the Transactions of the Royal Society of Edinburgh by Mr. Heath. Had I been sooner aware of the fact that Mr. Heath was preparing an elaborate discussion of the Calton Hill rock thermometers I should not have taken the trouble to make an harmonic analysis of the eight years' observations already published by Piazzi Smyth. These I have used as they were given, without any regard to the probable corrections. As my object was, however, to get an approximate estimate of the amount of heat stored in the rock at different times, and not to discuss the conductivity of the material, it was not necessary to pay much attention to comparatively small errors of observation. The probable heterogeneity of the different layers and the surface irregularities of the rock itself will give rise to disturbances as important as any that might arise from neglect of slight and, as Mr. Heath has pointed out, not very certain corrections.

It would be of great interest to apply similar calculations to underground temperatures in other parts of the globe, especially in parts which are blessed with fairly steady sunshine.

Table 9.—*Showing the time in hours, reckoned from culmination, at which for given values of the sun's declination, as shown in the top row, the radiation crossing unit horizontal surface, at the equator, has value as shown in the first column.*

R.	Sun's declination.			
	23° 27'.	20°.	12°.	0°.
0.700	....	......	......	0.00
0.679	....	......	0.00	......
0.643	....	0.00	......	......
0.622	0.00	......	......	......
0.606	0.77	1.12	1.55	1.68
0.512	1.98	2.11	2.34	2.46
0.421	2.69	......	......	......
0.331	3.27	3.35	3.48	3.54
0.249	3.79	......	......	......
0.091	4.73	4.76	4.81	4.83
0.060	4.94	......	......	......
0.007	5.47	5.49	5.51	5.52

Table 10.—*Total insolation at the equator.*

Declination.		Half-daily heating (relative).	Daily heating (absolute).
°	'		*Calories.*
+23	27	122.9	737.4
+20		127.4	764.4
+12		135.2	811.2
0		139.2	835.2
−12		135.2	811.2
−20		127.4	764.4
−23	27	122.9	737.4

[The numbers in the second column of Table 10 are shown in curve No. 7. They are calculated for the declinations in the first column, which latter correspond very nearly to the positions of the sun on the 20th or 21st of each month, from June to December, as we go down the column, and from December to June as we go up the column.]

In regard to the general form of the curves of underground temperature, there is one feature which I do not remember to have seen commented upon. The feature is apparent to all, but most evident in the curve for the thermometer nearest the surface. It is the sharpness of the crest as compared with the trough. The reason of this is at once recognized when we observe that exactly the same feature is distinctly characteristic of the lower solar radiation curve, but not so of the higher curve. In other words, in the higher latitude the low altitude of the sun and the shortness of the day combine during the winter months to produce a marked effect upon the law of absorption of solar energy. In lower latitudes this effect is hardly appreciable, and at the equator a perfectly symmetrical semiannual variation of comparatively small amplitude is to be expected. It is instructive to compare the annual variations of solar radiation already given for two different latitudes with the corresponding variations at a place on the equator. The results, obtained in exactly the same way [as for Tables 1, 2, 7, and 8], are given in Table 9.

Earth thermometers at the equator would, of course, show no annual period, and the semiannual period would penetrate to a comparatively small depth.

STUDIES ON THE CIRCULATION OF THE ATMOSPHERES OF THE SUN AND OF THE EARTH.

By Prof. Frank H. Bigelow, dated November 10, 1903.

I.—THE CIRCULATION OF THE SUN'S ATMOSPHERE.

HISTORICAL REVIEW.

That the solar atmosphere is circulating in accordance with the laws governing the convective and radiative action of a large mass of matter contracting by its own gravitation, is so evident that numerous efforts have been made to determine what these laws are, or at least to discover some reliable clue to a beginning of scientific research in that direction. The application by R. Emden[1] of H. von Helmholtz's method of adapting the general equations of motion to a solar mass, appeared to be a step in the right direction; further attention was called to the possibilities of this solution in my Report on Eclipse Meteorology,[2] pages 71–74. In June, 1902, Sir Norman Lockyer and Dr. W. J. S. Lockyer[3] published their suggestive curve of the percentage frequency of the solar prominences derived from the Italian observations for each 10° of solar latitude north and south of the equator. This curve interested me because it appeared to identify the distinctly solar phenomena with the short period curves which I had worked out in the terrestrial magnetic field and in the meteorological field of the United States, and first published in December, 1894,[4] afterwards republishing them in 1898.[5] A study of the difficult subject of inversion of periodic effects in magnetic and meteorological phenomena discovered at that time has been actively pursued by the Weather Bureau for the past ten years, and evidence is being accumulated, not only here but by others, of the existence and importance of the fact of inversion in the magnetic phenomena, the pressures, and the temperatures of the earth generally. The solar prominence curve suggested also the possibility of obtaining more decisive evidence of solar and terrestrial synchronisms than that afforded by the solar-spot frequency curve (which is apparently only a sluggish register of the true solar output of energy), because the terrestrial magnetic field and the meteorological elements show minor variations that are only feebly indicated in the solar-spot curve. The prominence frequency curves brought out distinctly for the sun the minor fluctuations that had been already found in the earth's atmosphere.

My first computations on the amplitudes of the deflecting forces which disturb the normal terrestrial magnetic field were computed for the years 1878–1893, using the records of several European magnetic stations. To have extended the same computation to the years 1841–1900, inclusive, would have re-

[1] Eine Beobachtung uber Luftwogen. R. Emden. Wied. Ann. LXII, p. 62, 1897, and Astrophysical Journal, January, 1902.

[2] Eclipse Meteorology and Allied Problems. Frank H. Bigelow. Weather Bureau Bulletin I. 1902.

[3] On some Phenomena which suggest a short Period of Solar and Meteorological Changes. By Sir Norman Lockyer, K. C. B., F. R. S., and William J. S. Lockyer, M. A., Ph. D., F. R. A. S. Received June 14. Read June 19, 1902. Addendum. Dated June 26. Proc. Roy. Soc. Vol. 70.

[4] Inversion of Temperatures in the 26.68 Day Solar Magnetic Period. Frank H. Bigelow. Am. Jour. Sci. Vol. XLVIII, December, 1894.

[5] Report on Solar and Terrestrial Magnetism in their Relations to Meteorology. Frank H. Bigelow. Weather Bureau Bulletin No. 21. 1898.

quired a vast amount of labor; as an equivalent, the deflections of the horizontal force alone, without the declination and vertical components, were derived by the construction of a series of graphical curves covering these sixty years, from which the mean ordinates were computed. The result was shown in my paper on Cosmical Meteorology, July, 1902.[6] The same variation curve was found from the horizontal force for the years 1878–1893 as that previously given by the computed σ curve, and it was therefore proper to conclude that this extension of the original computation in both directions was sufficiently correct for the purpose of the discussion. Furthermore, the prominence frequencies presented the material for studying the solar activity by zones, and the result of my compilation to determine the law of the movement of the points of prominence maxima in latitude was read before the American Association for the Advancement of Science on December 28, 1902, and published in the Monthly Weather Review, January, 1903.[7] I there showed that in each hemisphere the maxima of prominence frequency are grouped in two zones, and that in the zones near the equator, in latitudes about 20°, the maxima of frequency approach that plane in common with the sun spots and faculæ during the 11-year period, while in the zones in latitudes 50°–70°, the maxima simultaneously move toward the poles. This indicates a characteristic tendency of the solar circulation to spread from the middle latitudes toward the equator and toward the poles in two independent branches. In a paper[8] published in March, 1903, the Lockyers obtained a similar result for the same phenomena. They gave the life history of the sun in the separate 11-year periods between 1872–1901, whereas my paper had grouped these three available periods together for the sake of finding the average law. Dr. A. Ricco[9] has published similar studies of the movements of prominences in latitude for the years 1880–1902. The subject of the average distribution of the solar spots in longitude on the sun has been discussed by Dr. A. Wolfer,[10] and from it he derived some determinations of the solar rotation in different latitudes. In my paper of January, 1903, I stated that besides a study of the variable distribution of the prominences in latitude, an effort was being made by me to discover some clue as to their distribution in longitude, in order to learn whether or not there was an accumulation on certain meridians, and it is the result of this work that is contained in the present paper. We have discovered an unexpectedly clear insight into the solar circulation, and this tends to strengthen the line of argument which I have been developing during the past fifteen years to explain the mysterious synchronism at the earth, of which numerous symptoms have been noted, in many kinds of observations.

COMPILATION OF THE PROMINENCE OBSERVATIONS.

The prominences which appear on the edge of the disk of the sun have been carefully delineated by the Italian observers Secchi and Tacchini with stations at Rome and Palermo, also Ricco and Mascari, at Catania, working in cooperation, from March, 1871, till the present time in an unbroken series. Students of solar physics can not too gratefully acknowledge the value of the patient, laborious work which has been done by these observers, and the practical study of these data is likely to open up new and important lines of research. Beginning with March 1, 1871, the images of the solar disk have been published in the Memorie della Società degli Spettroscopisti Italiani, and they cover the time to the end of the century, except for a long gap from September, 1877, to January, 1884. I am informed by Dr. Ricco that the drawings for these missing years are in the archives of the Catania Observatory, and it is obvious that steps should be taken as soon as practicable to complete the published record, because the demand for the data is sure to increase, as can be inferred from the results indicated in this paper. On those graphical tables certain lines were drawn showing the position of the north and south poles and the equator of the sun, so that the disk could be readily divided into zones, passing first along the eastern limb from north to south, and then along the western limb from south to north.

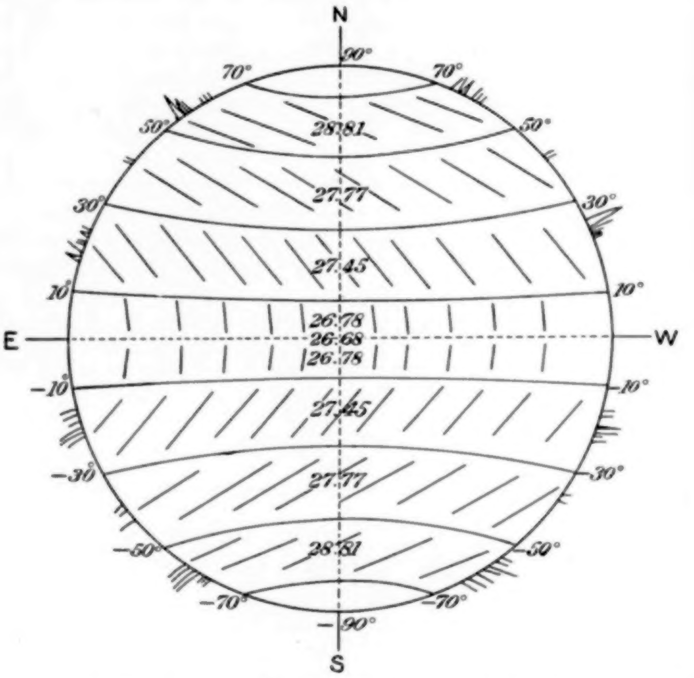

Fig. 1.—Retardation of rotation in different zones of the sun as derived from the prominence frequency in longitude.

The diagrams on fig. 1 serve to illustrate the general situation. Referring to fig. 4 of my former paper,[11] Synchronous Changes in the Solar and Terrestrial Atmospheres, it is noted that the prominence maximum activity is central in the zones 10° to 30° and 50° to 70° of each hemisphere, and on this account it was decided to subdivide the solar disk into 20-degree zones, as follows: + 90° to + 70°, + 70° to + 50°, ... — 50° to — 70°, and — 70° to — 90°, as indicated. A scale was prepared which when laid upon the published drawing of a given date would readily subdivide it into these zones on each side of the sun's limb.

For the sake of recording the relative energy of the solar output as registered in the prominences, a scale of estimation was adopted, as follows:

0 = an undisturbed limb for the zone.
1 = a minor disturbance.
2 = a somewhat extensive disturbance.
3 = a disturbance pronounced in altitude or along a considerable extent of the zone.
4 = a very large, emphatic agitation of the limb.
5 = the largest prominences, occurring but rarely.

The state of the limb was thus expressed in numbers of relative energy by estimation, care being exercised to make a similar relative number do duty whenever the style of the

[6] A Contribution to Cosmical Meteorology. Monthly Weather Review, July, 1902, Vol. XXX, p. 347.

[7] Synchronous Changes in the Solar and Terrestrial Atmosphere. Monthly Weather Review, January, 1903, Vol. XXXI, p. 9.

[8] Solar Prominence and Spot Circulation, 1872–1901, By Sir Norman Lockyer, K. C. B., F. R. S., and William J. S. Lockyer, Chief Assistant, Solar Physics Observatory, M. A. (Camb.), Ph. D. (Gott) F. R. A. S. Received March 17. Read March 26, 1903. Proc. Roy. Soc. Vol. 71.

[9] Le protuberanze solari nello'ultimo periodo undecennale. Mem. Spett. Ital., Vol. XXXII, 1903. A. Ricco.

[10] Publikationen der Sternwarte des Eidg. Polytech. Inst., Zurich. A. Wolfer. Bd. I, II, III, 1897, 1899, 1902.

[11] Monthly Weather Review, January, 1903, Vol. XXXI, p. 17.

TABLE 1.—*The prominence energy in zones as collected on the 26.68-day period, showing retardation in different latitudes.*

Period 26.679 days; Epoch June 13.72, 1887.

Zone +50° to +70°.

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
1891	Jan. 11	1		3	2												1	1												
	Feb. 6	2	1			1	2	2	2		4	2									2	4	4	2	3	2	2	2		
	Mch. 5	3		4	3		2			1															2					
	Apr. 1	4	2		2		4	3	2					1		1		1		2	2						1			
	Apr. 27	5						3	1										2		1									
	May 24	6	2		1				1	4	3	5	3	2	1				1			1		1						
	June 20	7	1			1				5	2	3	3	6	3		1	5	1	1	2	3								
	July 11	8	1							2	3	2	2	1	2	3	1	1	2	1	1	1	1	1			2		2	
	Aug. 12	9						1	1					2	4	8	5	4	5	4	5	4	4	3	1		1		1	
	Sep. 8	10			1	2	6	7	8	6	4	6	4	1	1	2	5	5	3	7	7	7	6	3	4	3	3	3		
	Oct. 4	11	4	2	3		4	3	4	3	1		3	4	4	8	3	6	3	4	6	7	8	3	3	7	4	2	1	
	Oct. 31	12		4						5		4	2		1	2	3	3	3	3	3	4	4			3		4		
	Nov. 27	13	2	1	2			2	2	4	4	4	3	4	3	1					2	2	2	1	2	2	2			
	Dec. 23	14			1	2					2	1				1	1				2	6			1					16
1892.	Jan. 19	1		1	2	1				1				2			2	1	5	3	1	1	1					1	1	
	Feb. 15	2			4			1	2			3		1				4			1	2			3			2		
	Mch. 12	3	3	3	3		2	1	2	3	2	3	4			2	2	2			1	1	1	2	2	1	2	4		
	Apr. 8	4	6	6	3	2		4	3	3			1	1	1	4	3	1	1		3	2	3		1	6	3	5	2	
	May 5	5	3	1	2	3	3		2	2	4	3	3	3	2				3	3	1	1		2			2	3		
	May 31	6	1	2		2	2	3	3	3	2	4	6	5	2	4	1		1	4	3	3	3	2	1	1	1	1	2	
	June 27	7	4	3	2	1		2	2	3	3	3	3	2	3	7			1		3	2	5	6	5	2	4	2	1	
	July 24	8	3	1	1				3	2	1	5	3	4	2	3	4	4	6	3	4	3		2	3	2	3	2		
	Aug. 19	9		3	3	1		1		1	2	2	4	1	5	5	5	3	4	4	4	4	4		2	2	2	3	1	
	Sep. 15	10	4			3		3	1		2		1	1	1	5	3	4	5	1	5	4	1	1	1			1		
	Oct. 12	11	3	3		1	1	5	4		2		2	1	2	1	2		3	5	2	3	2	5	1	2	2	6		
	Nov. 7	12	6	3		1	2							3	1		2		2	3	6	3	3	4	5		6	4	3	
	Dec. 4	13		3	3	3			4		2						2	2	2		2				2					17

Zone +10° to +30°.

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
1891	Jan 11	1			1	2									2	5	3	2	2				2				1	1		
	Feb. 6	2	2	5	2	1		1	1	1			1	1	2	2	1	2	1	1		2	1	1	1	4	3	1		
	Mch 5	3	2	3				1			1			2	1		6	6	2	6	3						2	2		
	Apr. 1	4	1		2	1	3	2	4	3				1	1	2	1	1	1	4	2	2						1		
	Apr. 27	5	1		1	1		3		1	3	2			1	3		1		1	3	1	3	1	1		1	3	1	
	May 24	6	1		1	2	2	1	1	4		1		1	5	8	2	1	2		3	4	4	3	4	1	4	5	2	
	June 20	7	3	3	3	2	1		1	3	4	3		7	3	7	3		1	2			3	2	3	2	3	3		
	July 11	8	3	5	1	2	1	3	2	6	4	4	2	1	3	4	5	5	1							2	4			
	Aug. 12	9	4	4	6	4	3	3	4	2	1	2	2	2	1	5	3	4			1	1			1		2	5	3	
	Sep 8	10	4	3	5	4	5	4	5	2	2	2	1	3			3	2		2		1				4	5			
	Oct. 4	11		2	4	1	3	1	2		2	1	2	1			1		1	3			1		1	1			1	
	Oct 31	12		2			1	2	3	2		3					4	1	2			1			4					
	Nov. 27	13					1	7		4	3	2		1	1	2	4	2					4	4	2	1	2	1		
	Dec. 23	14			1				2		2	2		2	1	1			1		2	6		3		1	1	1		14
1892	Jan 19	1	1					2	2	2			3	2	2	4	1			2	4		4			2			1	
	Feb 15	2			2	1			2			7	5	4	4		4	1	2		4	3			3	3				
	Mch 12	3	2	1		3	3			1		3	3	3	2	2					5	5	2	2	1					
	Apr. 8	4	1		2	6	5	3	2			1	4	3	1					1	2		4		4		3		1	
	May 5	5	2		2		1			3					1			2	1			3	1	1	6	1	3	5		
	May 31	6	5			1	3	2		2		3	4	3	2	3	4	2	3			2	3	2		3	2	1	1	
	June 27	7	3	6	5	1	4	1	6		1	2	4	3	4	5	3	2	4	1	1	2	2	3	3	5	2	3	1	
	July 24	8	1	4	2		1	3	4	2	1	4	2			3	4	1	4	4	3	2	1	5	5	6	3			
	Aug. 19	9	4	4	3	3	2	1	3	1	2	3			2	3	4	2	3	6	5	2	1	1		6	1	4		
	Sep. 15	10	2	2	3	3			3	3		1	1		1	4	1	3	5	4	7	3	2	5	3		2	2	1	
	Oct 12	11	3	2	1		2	1		2			1			3	3	1	3	3	4	3	2	2	2	2	2	3		
	Nov. 7	12	3			1			3	3		1	4	2	1		1	1		4	6	4	5	6	5			1		
	Dec. 4	13	2	4	5	5	2	1	2	1		1	2	2	1		2	3	1			2	2		3				2	
										16															15					

drawing changed from one draftsman to another. The computation sheets were arranged to allow the data for each of the nine zones to be collected together by years for the first compilation. For the second compilation the data belonging to the same zone for the successive years were brought together. Hence, the work of tabulating the data was repeated twice throughout the series. For an ephemeris I used the one already constructed from my computation on the variations of the terrestrial magnetic field, having the period 26.679 days and epoch June 13.72, 1887, as given on page 120, Bulletin No. 21, Solar and Terrestrial Magnetism. This is known to coincide very closely with the period of the *solar rotation at the equator*, and as it was one purpose of this research to test practically the working of this period, it was laid at the basis of the compilation. It makes no difference what ephemeris and period are adopted, since any periodic phenomenon not falling upon that period will show a gradual departure from it by the trailing of the numbers on the sheet from left to right, if the period is too short, or from right to left, if it is too long.

An example of the use of the ephemeris and the result is given in Table 1. One point should be especially noted in this connection, and that is as follows: *The same meridian of the sun is seen twice in a single rotation, first as the eastern limb, and second, thirteen days later, as the western limb.* Whatever may be the intrinsic activity of the sun at a given zone and on a given meridian, that display becomes visible twice, first to the east and second to the west. During the passage of that meridian across the sun's disk the record is wanting so far as this series is concerned, though it could of course be studied otherwise by means of the spectro-heliographic photographs. Thus, as the successive meridians come to the edge of the disk, their output is recorded on the respective drawings. When these are collated with the equatorial period, whatever characteristics they may have which would imply special centers of solar activity will gradually emerge upon the numerical tables. As it is not possible to reproduce these extensive tables in this connection, two specimens of the second collection are shown on Table 1 for the years 1891 and 1892 in succession, and for the zones +50° to +70° and +10° to +30°. Imagine that similar tables for zones +50° to +70° extend from 1871 to 1900, inclusive, except for the gap from 1878-1883, arranged continuously so that the prominence concentration and depletion flows without break on the sheet from year to year. This process is extended to the 9 zones, each 20° in width. In the first collection of the data the highest number was 5, and this was very rarely entered. Since the same area on the sun is seen twice, there may be two entries within the same tabular area on the *first set of sheets*. In the *second set of sheets* these numbers are added together and entered as one, so that occasionally the figures 6, 7, 8 occur, as in Table 1. They represent the largest disturbance occurring in one small area of the sun, as defined by the latitude and longitude thus prescribed. If now the maxima show a tendency to trail across the sheet as indicated by the continuous lines drawn athwart the table, instead of being scattered at random, then this is evidence that the center of eruption itself rotates about the sun at a different rate from that laid down in the assumed ephemeris. From such trails the angular retardation in different zones can be computed with considerable exactness. The reader will not receive a satisfactory impression of the distinctness with which this trailing at different rates in the several zones occurs, without an inspection of the entire series of tables, and it is hoped that they will be published in a special report, as the subject matter is evidently very important and suggestive for the solution of the fundamental problem of the mode of the internal solar circulation.

An examination of these sheets indicates that there is a marked tendency for the numbers to bunch themselves together in a very special manner. Between the successive years there is generally a depletion corresponding with the winter months, while the summer months are relatively full and complete. As pointed out in my paper on Synchronous Changes, this is evidently due to the fact that the relatively cloudy weather in Italy during the winter months made it impossible to secure so many days of observation as during the summer, and I conclude that the apparent concentration of the tables in the summer season is a meteorological effect, and should be treated as such in interpreting the results. At the same time there is a very similar concentration of the numbers along the days of the period, corresponding with a solar rotation, which can not be explained in that way, since it occurs as prominently in summer as in winter. It must apparently be referred back to some solar activity producing prominences on the two opposite sides of the sun. The *maximum numbers* not only trail downwards and to the right on the tables, but the *lines of maximum* also drift across the tables to the left, thus indicating retardation in the higher latitudes relative to the adopted equatorial period.

It may be mentioned in passing that this increase of activity of the sun on two opposite sides of its mass, as if a certain diameter had greater energy than the one at right angles to it, has already been detected by me in the meteorological field of the earth's atmosphere, and also in the terrestrial magnetic field, as shown on pages 91 and 92 of my Eclipse Meteorology and Allied Problems, and elsewhere. This persistent excess of outflowing energy on two opposite sides of the sun suggests the possibility that *the sun should be regarded as an incipient binary star*,[12] where the dumbbell figure of revolution prevails instead of the spheroidal. If this is really the case, and the evidence suggests it, then there would be a reason for the existence of the two primary centers of activity in the sun, instead of its having a single center. Some double acting system appears to impress itself generally upon the solar cosmical relations. From this we should expect to find that the sun has two magnetic and two meteorological systems, interacting so as to form the configuration of the external field as measured at the earth. There would then be sufficient ground for a differential action in the terrestrial pressures and temperatures, as detected in the discussion of such data by many students.

This view is quite in harmony with the well known fact of the existence of numerous binary systems of suns more or less widely separated, and it can not be regarded as unlikely that the sun is actually developing in this way. The enormous mass of the sun would seem to entice its constituents to group themselves preferably about two centers for the physical processes involved in circulation and radiation, rather than about one, and I suspect that this is the correct explanation of several well known phenomena.

DISCUSSION OF THE OBSERVATIONS.

On Table 1 are given some examples of the slope of the line of maximum frequency numbers in successive years. These were drawn originally by a careful examination of the entire set of figures, and an effort was made to locate the line along the maximum numbers so as to balance as nearly as possible the entire system on either side of it. Some regard was paid to the average trend of the lines in the other portions of the same zone, whereby one's judgment was guided in cases of doubt. Entire impartiality was exercised as far as practicable, and the results now about to be described were entirely unexpected. It would perhaps be preferable to utilize least square methods, if one could afford so great labor. The lines are all numbered, as 16, 17 in the zone + 50° to + 70°, which are complete; those in zone + 10° to + 30°, namely

[12] Compare Figures of Equilibrium of Rotating Masses of Fluids. By G. H. Darwin, Proc. Roy. Soc. Vol. XLII. 1887, p. 359. Thomson and Tait, Nat. Phil. Vol. I, part 2, pp. 330-335.

14, 15, 16, are fragmentary on Table 1. We now count the number of days which have elapsed for a certain number of periods, in order to find the average rate of retardation per rotation of 26.68 days. Thus, for the line 16, zone + 50° to + 70°, about 12 periods elapsed, beginning with period 2 and ending with period 14, while the line was trailing, or the period was retarded, 26.7 days. Hence, 26.7 ÷ 12 = 2.225 days retardation per period of 26.68 days, so that the rotation period in that zone is 28.905 days. Similarly, line 17 gives a retardation of 26.2 days in 11 periods. Hence, 26.2 ÷ 11 = 2.382. These two values are entered in the proper place on Table 2. The results have been grouped by years where the solar energy is passing from maximum to minimum, 1871–1877, 1884–1888, 1894–1900, and again where it is passing from minimum to maximum (1878–1883, lacking), 1889–1893, so as to study the effect of this variation in the retardation; but the unfortunate gap 1878–1883 prevents a satisfactory comparison between these two groups. The several zones are given separately for each hemisphere, and the successive trails can be readily scrutinized.

The first column of Table 2 contains the years of the groups; the second the slope of the 11-year curve, roughly; the third the number of the line in the zone; the fourth the number of periods elapsed; the fifth the number of days of retardation

TABLE 2.—*Retardation of the sun in different latitudes as derived from the prominence frequency in longitude.*

Years.	Slope.	Line.	Periods.	Days.	Retardation.	Line.	Periods.	Days.	Retardation.
		Zone + 10° to − 10°.							
1871–1877	Max.–Min.	1	90	9.0	0.100	...	...	...	...
		2	90	9.0	0.100	...	...	...	...
1884–1888	Max.–Min.	3	69	6.5	0.094	...	...	...	...
		4	69	7.4	0.107	...	...	...	...
1889–1893	Min.–Max.	5	68	5.2	0.077	...	...	...	...
		6	68	6.0	0.088	...	...	...	...
1894–1900	Max.–Min.	7	96	11.4	0.119	...	...	...	...
		8	69	8.2	0.119	...	...	...	...
		Mean.........			0.101				
		Zone + 10° to + 30°.				Zone — 10° to — 30°.			
1871–1877	Max.–Min.	1	18	12.8	0.711	1	15	12.5	0.833
		2	41	28.2	0.688	2	28	22.1	0.789
		3	39	26.1	0.669	3	38	26.5	0.697
		4	35	25.3	0.723	4	39	27.0	0.692
		5	25	20.2	0.808	5	37	27.0	0.729
		6	26	17.8	0.684	6	26	19.0	0.731
		7	9	6.0	0.666	7	10	7.3	0.730
1884–1888	Max.–Min.	8	19	14.0	0.737	8	16	14.0	0.875
		9	34	26.0	0.765	9	31	27.0	0.873
		10	35	26.0	0.743	10	33	26.7	0.809
		11	35	25.0	0.714	11	35	26.5	0.803
		12	10	7.2	0.720	12	17	14.0	0.824
1889–1893	Min.–Max.	13	18	16.2	0.900	13	16	13.6	0.850
		14	31	26.7	0.863	14	34	26.8	0.788
		15	31	26.2	0.845	15	34	26.7	0.785
		16	23	19.0	0.826	16	27	22.0	0.815
1894–1900	Max.–Min.	17	33	26.3	0.797	17	33	26.4	0.800
		18	37	26.7	0.722	18	35	27.0	0.722
		19	35	27.8	0.794	19	34	26.6	0.783
		20	34	26.6	0.783	20	36	28.0	0.778
		21	28	20.7	0.739	21	35	26.8	0.766
		...	...	...	...	22	34	24.0	0.706
		...	...	...	...	23	13	9.8	0.753
		Mean.........			0.757	Mean.........			0.782

TABLE 2.—*Retardation of the sun in different latitudes as derived from the prominence frequency in longitude*—Continued.

Years.	Slope.	Line.	Periods.	Days.	Retardation.	Line.	Periods.	Days.	Retardation.
		Zone + 30° to + 50°.				Zone — 30° to — 50°.			
1871–1877	Max.–Min.	1	15	21.0	1.400	1	18	19.8	1.100
		2	20	27.0	1.350	2	26	27.0	1.038
		3	20	27.4	1.370	3	27	26.4	0.978
		4	19	28.0	1.474	4	25	27.3	1.092
		5	18	27.4	1.522	5	24	26.7	1.112
		6	18	27.3	1.517	6	27	27.7	1.026
		7	24	33.0	1.375	7	24	24.6	1.025
		8	21	25.3	1.205	8	10	9.9	0.990
1884–1888	Max.–Min.	9	20	24.2	1.210	9	15	14.5	0.967
		10	21	27.0	1.286	10	28	26.0	0.929
		11	22	27.2	1.236	11	27	23.6	0.874
		12	23	27.5	1.196	12	32	27.2	0.850
		13	21	27.5	1.309	13	29	27.2	0.938
		14	19	26.0	1.368	...	...	...	...
1889–1893	Min.–Max.	15	22	27.0	1.227	14	28	27.0	0.964
		16	23	27.0	1.174	15	29	27.8	0.958
		17	24	27.0	1.125	16	32	27.2	0.850
		18	24	27.5	1.146	17	27	27.2	1.007
		19	25	27.7	1.108	18	26	26.0	1.000
		20	26	27.0	1.038	...	...	...	...
1894–1900	Max.–Min.	21	27	27.4	1.015	19	30	27.8	0.927
		22	26	27.0	1.038	20	29	27.2	0.938
		23	30	27.0	0.900	21	23	26.0	1.130
		24	35	26.5	0.786	22	25	27.0	1.080
		25	28	26.2	0.936	23	29	28.0	0.965
		26	27	23.8	0.881	24	30	27.0	0.900
		Mean.........			1.192	Mean.........			0.989
		Zone + 50° to + 70°.				Zone — 50° to — 70°.			
1871–1877	Max.–Min.	1	13	27.7	2.131	1	11	20.6	1.873
		2	13	27.0	2.077	2	15	26.6	1.773
		3	14	27.0	1.928	3	13	27.0	2.077
		4	11	27.3	2.482	4	12	27.0	2.250
		5	13	27.5	2.115	5	15	27.4	1.827
		6	15	27.0	1.800	6	15	26.8	1.787
		7	19	27.3	1.437	7	9	19.0	2.111
		8	8	14.0	1.750	...	...	...	...
1884–1888	Max.–Min.	9	18	27.7	1.539	8	10	26.0	2.600
		10	18	28.0	1.556	9	10	26.2	2.620
		11	21	27.6	1.314	10	12	27.8	2.317
		12	19	27.3	1.437	11	13	26.4	2.031
		13	14	27.7	1.979	12	11	26.5	2.409
1889–1893	Min.–Max.	14	14	27.7	1.979	13	11	26.0	2.364
		15	15	27.4	1.827	14	12	26.6	2.217
		16	12	26.7	2.225	15	11	27.8	2.527
		17	11	26.2	2.382	16	11	27.0	2.455
		18	13	28.0	2.154	17	11	26.4	2.400
		...	...	...	...	18	12	27.5	2.292
1894–1900	Max.–Min.	19	15	27.0	1.800	19	13	26.0	2.000
		20	13	27.0	2.769	20	11	27.0	2.455
		21	9	26.0	2.889	21	10	27.5	2.750
		22	10	27.4	2.740	22	11	27.0	2.455
		23	10	27.5	2.750	23	15	26.4	1.760
		24	11	27.5	2.500	24	18	27.6	1.533
		25	12	27.0	2.250	25	17	27.7	1.629
		Mean.........			2.072	Mean.........			2.180

in these periods; the sixth the average retardation in days on the 26.68-day period. The mean retardation for each zone in both hemispheres is given, and has been collected in Table 3. It was necessary to assume that the mean latitude of the occurrence of the prominences is in the middle of each zone, though this can not be strictly correct. It would require very extensive computation to determine the mean latitude of

occurrence of the several zones more accurately. The aspect of the path of maximum frequency as given on fig. 4 of my previous article entitled Synchronous Changes,[13] is favorable to this simple assumption.

TABLE 3.—*Mean retardation by zones.*

Mean latitude.	Retardation.			Mean period.
	North.	South.	Mean.	
°				
0	0.000	0.000	0.000	26.68
5	0.101	0.101	0.101	26.78
20	0.757	0.782	0.770	27.45
40	1.192	0.989	1.091	27.77
60	2.072	2.180	2.126	28.81

A careful examination of the individual determinations of the retardations in the several zones shows that there is a wide fluctuation which increases in magnitude from the equator toward the poles. In order to obtain a clear idea of the law of the retardations these results have been plotted on fig. 2.

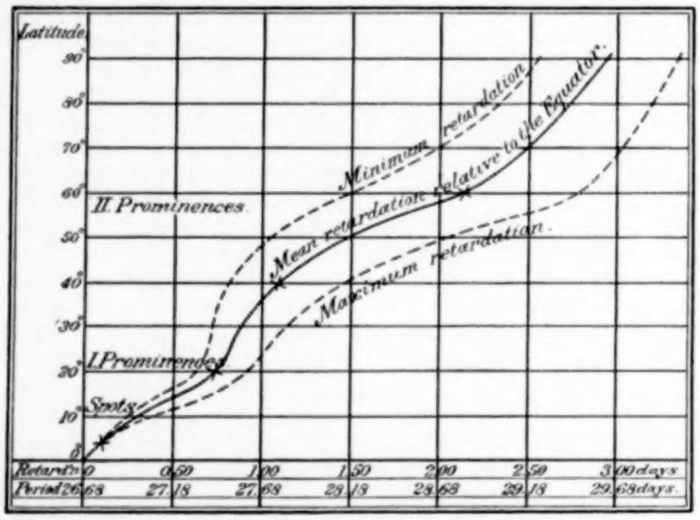

FIG. 2.—Periods of rotation of the solar photosphere derived from the prominence frequency in different zones.

TABLE 4.—*Bigelow's rotation periods.*

Latitude.	Daily angular velocity.	Sidereal period.	Synodic period.
°	′	*Days.*	*Days.*
Pole 90	788	27.40	29.63
85	790	27.32	29.54
80	793	27.23	29.43
75	795	27.15	29.33
70	799	27.03	29.18
65	804	26.86	29.00
60	809	26.70	28.81
II Pr. 55	815	26.50	28.58
50	824	26.20	28.23
45	832	25.94	27.93
40	837	25.81	27.77
35	840	25.71	27.66
30	842	25.66	27.60
25	845	25.57	27.50
I Pr. 20	846	25.53	27.45
15	852	25.36	27.26
Spots 10	859	25.15	27.00
5	866	24.95	26.78
Equator 0	869	24.86	26.68

[13] Monthly Weather Review, January, 1903, Vol. XXXI, p. 17.

The mean retardation, with an approximate maximum and minimum retardation, is there indicated. From the mean line I have scaled off the corresponding synodic periods for every five degrees of latitude, as given in Table 4, and have computed the sidereal period and the daily angular velocity, X, in minutes of arc belonging to them. These transformations can readily be made by interpolations from Table 5.

The latitude at which the maximum of spots is commonly observed, and also the latitude of the maxima I and II of prominence frequency, are indicated in Table 4 and fig. 2 by the terms "Spots," "I Pr.," "II Pr."

TABLE 5.—*Transformations of the daily angular velocity into sidereal and synodic periods.*

T=sidereal period of the sun; E=sidereal period of the earth; S=synodic period of the sun. Then we have $\frac{1}{T}-\frac{1}{E}=\frac{1}{S}=\kappa-n$.

Daily X	T	$\frac{1}{T}=\kappa$	$\frac{1}{E}=n$	$\frac{1}{S}$	S
′					
900	24.00	0.04167	0.00274	0.03893	25.69
895	24.13	0.04144		0.03870	25.84
890	24.27	0.04120		0.03846	26.00
885	24.41	0.04097		0.03823	26.16
880	24.55	0.04074		0.03800	26.32
875	24.69	0.04051		0.03777	26.48
870	24.83	0.04028		0.03754	26.64
865	24.97	0.04005		0.03731	26.80
860	25.12	0.03982		0.03708	26.97
855	25.26	0.03958		0.03684	27.14
850	25.41	0.03935		0.03661	27.32
845	25.56	0.03912		0.03638	27.49
840	25.71	0.03889		0.03615	27.66
835	25.87	0.03867		0.03592	27.84
830	26.02	0.03843		0.03569	28.01
825	26.18	0.03819		0.03545	28.21
820	26.34	0.03796		0.03522	28.39
815	26.50	0.03773		0.03499	28.58
810	26.67	0.03750		0.03476	28.77
805	26.83	0.03727		0.03453	28.96
800	27.00	0.03704		0.03430	29.15
795	27.17	0.03681		0.03407	29.35
790	27.34	0.03657		0.03383	29.56
785	27.52	0.03634		0.03360	29.76

It should be noted that the mean retardation does not follow a regular slope, or a simple curve that can be reduced to an analytic function. From latitude 20° to 40° there is a smaller inclination than on the slopes between 0° and 20°, or on those between 40° and 60°. In fig. 2 the line has been extended to 90°, that is to the pole, but it is unknown beyond 70°, since the polar zones were too irregular to permit any use of this method. It is probable that a continuous line, as indicated, is nearly correct.

In order to compare my result with some well known rotation periods, (taken conveniently from Miss Clerke's Problems in Astrophysics, p. 146), the following compilation is introduced:

Heliographic latitude.	Spots.	Prominences. (Bigelow).	Faculæ.
°			
0	25.09	24.86	24.66
15	25.44	25.36	25.26
30	25.81	25.66	25.48

From this it appears that my prominence rotations lie midway between those of the spots and the faculæ. Duner's rotations for the reversing layer, as quoted by Miss Clerke, are apparently impossible. The determinations of the rotation period as given by the well-known formulæ of Carrington,

Spoerer, Faye, and Tisserand are found in Table 6. These periods begin to depart from the rotations as found from the prominences after leaving the latitude of 20°.

TABLE 6.—*Several denominations of the rotation periods of the solar spots in different latitudes.*

	Carrington.			Spoerer.		
d	*X*	*T*	*S*	*X*	*T*	*S*
°	′			′		
0	865	24.97	26.80	877	24.65	26.42
5	863	25.03	26.90	864	25.00	26.83
10	857	25.20	27.07	853	25.32	27.21
15	849	25.44	27.35	842	25.65	27.59
20	840	25.71	27.66	833	25.93	27.91
25	828	26.08	28.09	825	26.18	28.21
30	816	26.47	28.54	819	26.37	28.43
35	803	26.93	29.04	814	26.53	28.62
40	789	27.38	29.60	810	26.67	28.77

	Faye.			Tisserand.		
d	*X*	*T*	*S*	*X*	*T*	*S*
°	′			′		
0	862	25.06	26.90	858	25.18	27.04
5	861	25.09	26.93	857	25.20	27.07
10	856	25.23	27.11	853	25.32	27.21
15	850	25.41	27.32	847	25.50	27.42
20	840	25.71	27.66	840	25.71	27.66
25	829	26.05	28.05	830	26.02	28.01
30	815	26.50	28.58	819	26.37	28.43
35	801	26.97	29.11	806	26.80	28.92
40	785	27.52	29.76	793	27.24	29.43

It is proper to remark that the agreement in low latitudes, between the periods obtained from the prominences, the spots, and the faculæ is not unfavorable to a feeling of confidence in the results obtained by the prominence method in higher latitudes. This is perhaps strengthened by the further developments which are indicated in the next section.

[THE DIFFERENTIAL CIRCULATION WITHIN THE SUN.

In order to study more minutely the meaning of the fluctuations in the relative retardations given for successive lines in Table 2, it is seen that we have practically obtained a value of the retardation for each year of the interval 1871–1900, except for the gap 1878–1883, and that by plotting these as ordinates on a diagram whose abscissas are the years, a curve of relative retardation in the several zones can be constructed. Fig. 3 exhibits these data in a graphical form. Thus, in the northern hemisphere, for the zone + 50° to + 70°, the ordinates in Table 2, beginning with that for 1871, read 2.13, 2.08, 1.93, ... 2.25, and these form the successive points of the retardation curve. In the upper section of the diagram marked "Prominence frequency" is reproduced the curve of average prominence frequency for the entire sun, which is the mean curve of the zonal system shown on fig. 2 of my paper on Synchronous Changes,[14] and is also reproduced at the head of fig. 28 of my paper, A Contribution to Cosmical Meteorology.[15] An inspection of the curves of fig. 3, shows plainly three important facts of fundamental significance: (1) the retardations relative to the equatorial period of rotation, 26.68 days, increase toward the poles; (2) the irregularities in the observed retardations are very much greater in the polar than in the equatorial zones; (3) these irregularities in the retardation do not appear to be accidental, but they synchronize closely with the variations in the frequency of the prominences. The value of this last inference is very great, in view of the other facts brought out in various portions of my research. Using this prominence curve as the standard of reference we have already proved the following facts: (1) The elements of the earth's magnetic field fluctuate

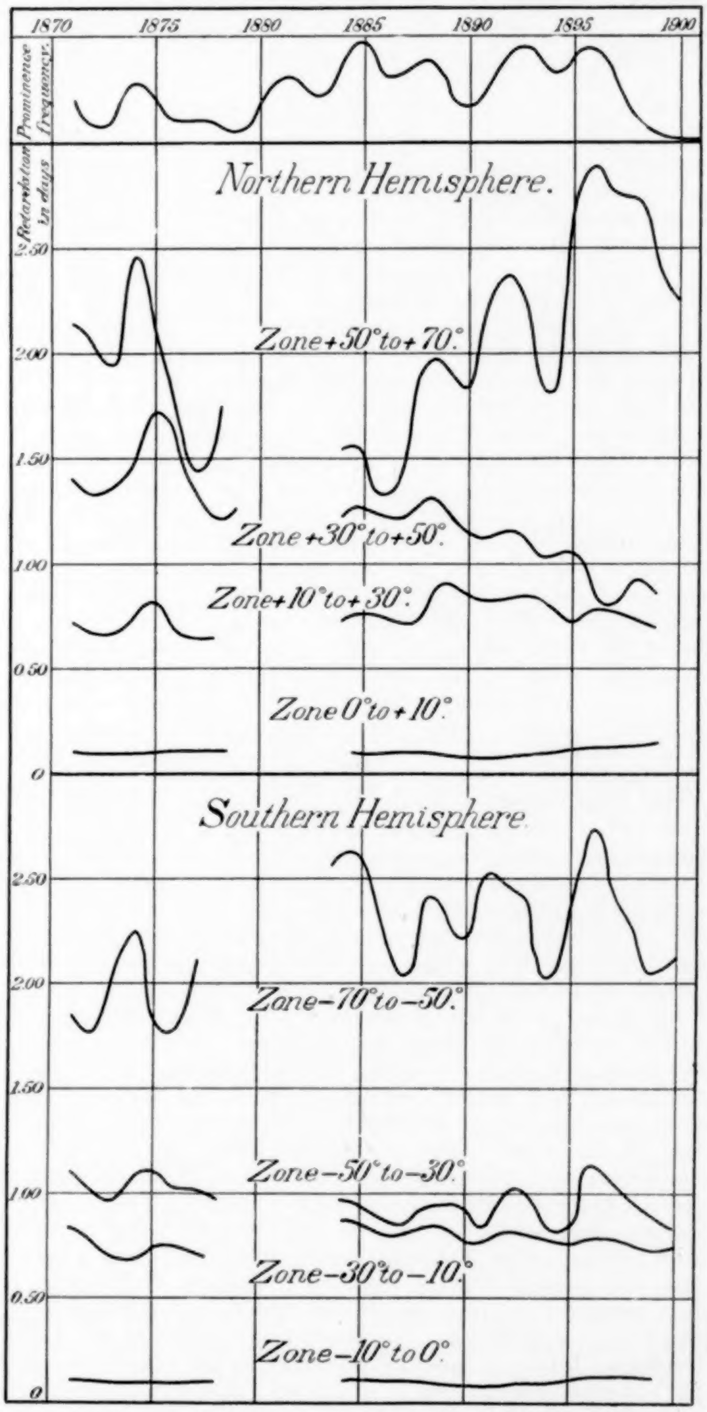

FIG. 3.—Variable retardations in the periods of rotation of the solar photosphere.

with it annually in synchronism; (2) the terrestrial temperatures and barometric pressures synchronize with it, as will be shown conclusively in my next paper, in the MONTHLY WEATHER REVIEW for November, 1903; (3) the internal circulations of the sun, as recorded in the rotational velocities of the photosphere, also synchronize with the same curve. This exhibit binds the entire solar and terrestrial atmospheres in one synchronous circulation, and it therefore places the entire subject

[14] Monthly Weather Review, January, 1903, Vol. XXXI, p. 10.
[15] Monthly Weather Review, July, 1902, Vol. XXX, p. 352.

of cosmical meteorology upon a satisfactory basis, entirely in harmony with the procedure marked out in previous papers.

While it can not be supposed that this discussion of the solar prominence frequency in longitude gives us final quantitative results on the rotation phenomena of various zones, yet the line of argument is sufficiently sustained to warrant further extensions of the research. We have shown that the solar angular velocity diminishes from the equator toward the poles at a certain rate, as on fig. 1 for example, or as on fig 4.

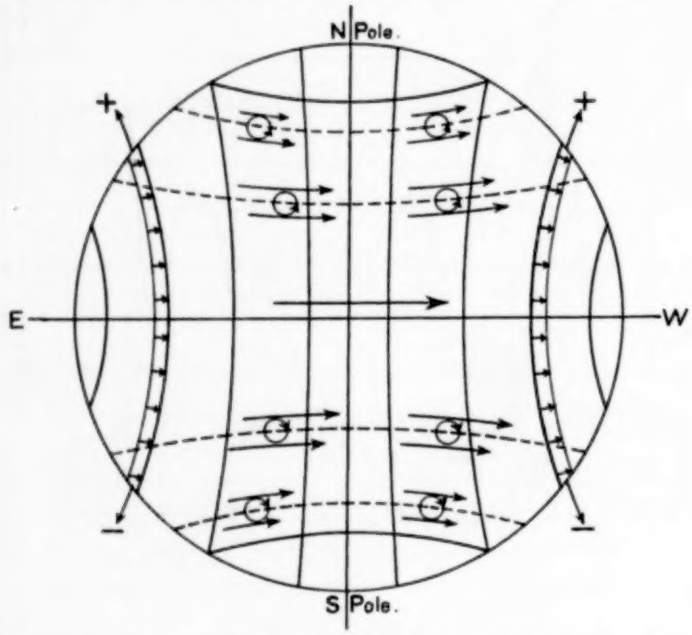

FIG. 4.—Formation of vortices in the solar mass by differential rotations.

This is in harmony with the von Helmholtz-Emden equations for a rotating mass hot at the center and cooling toward the surface.[16] In such a mass there are discontinuous concave cylindrical surfaces coaxial with the axis of rotation, the equatorial parts being nearer the axis than are the polar parts. This also implies that the polar regions of the sun are warmer than the equatorial by reason of the currents from the center toward the poles. At a surface of discontinuity, on each side of which the pressure is the same, but the temperature and angular momentum different, as where a rapidly moving current flows over a more slowly moving current in the earth's atmosphere, the conditions are favorable for forming vortex tubes, terminating on the surface, but extending through the mass of the sun. They are right-handed in the northern hemisphere and left-handed in the southern hemisphere, for convective actions from the equator toward the poles. If vortices are thus formed in the sun, so far as the state of its material permits, then the solar mass is in fact in a polarized state, the internal matter tending to rotate throughout the globe around such lines as are the generators of the required discontinuous surfaces. The turbulent conditions of internal circulation tend to a lawful disposition by the regulative action of a hot mass gravitating to a center by its own internal forces and emitting heat through these processes of circulation accompanied by polarization and rotating vortex tubes. The contents of a tube must be made up of molecules and atoms more or less charged with electricity, and the necessary rotatory motion produces Amperean electric currents which are a sufficient cause for the generation of a true magnetic field, positive on the northern and negative on the southern hemisphere of the sun. This conforms to the result reached years ago by my analysis of the terrestrial magnetic field, which showed that the earth appears to be immersed in a magnetic field perpendicular to the plane of the ecliptic and positive to the north of it. Variable circulation within the solar mass would display itself in corresponding changes in the rotation of the discontinuous surfaces, in the vortices carrying electrical charges, in the external magnetic field, in the number of prominences, faculae, and spots, in the earth's magnetic and electric fields, and in the terrestrial temperatures and pressures. Synchronism having thus been established throughout this vast complex cosmical system and referred back to fundamental thermodynamic and hydrodynamic laws, it becomes possible to make further advances in the problems of solar physics. Thus, the curvature of the internal lines can be studied in different parts of the meridian section on passing from the surface of the sun to internal parts by means of the vortex law of constant angular momenta, $\Omega = \omega \varpi^2$, under the assigned thermal conditions. We shall make an attempt to do this in a report which will contain the tabular data in full upon which these deductions are based.

If it is true that large cosmical cooling masses in rotation contain a polarized or vortical internal structure which is the basis of a magnetic field, then it follows that this is the explanation of the earth's magnetism as well as of the magnetism of the sun. Hence, all stars are magnetized spheres, and their relative magnetism would be a measure of the activity of their internal circulations. Thus, the relative intensity of the earth's and the sun's magnetization becomes a measure of the internal vortical circulation in polarized tubes, and the variations of the earth's magnetic field have a cosmical significance, not only as to the direct action of the sun as a great rotating variable magnet, but as a measure of the forces which go to make up the solar output in several manifestations of energy. The summary of this line of thought may be found in chapter 4 of my "Eclipse Meteorology." It is proper to renew my objection to the results derived by other investigators for any solar rotation period which is shorter than 26.68 days, because it does not seem to be possible in view of the above analysis of solar conditions. Thus, we must reject Spoerer, 26.32; Broun, 25.92, 25.86, and 25.83; Hornstein, 26.39, 26.03, 26.24, and 25.82; Liznar, 26.05 and 25.96; Müller, 25.66, 25.79, 25.86, 25.87, and 25.47; von Bezold, 25.84; Hamberg, 25.84; Ekholm and Arrhenius, 25.93; Schuster, 25.809 or 25.825. The numerous computations, giving results so widely different from that apparently ruling in the sun as derived from observations upon its own material, seem to indicate that the application of these several methods of computation to terrestrial data raises grave doubts as to their value. There are numerous difficulties in applying least square methods to solar-terrestrial data in the present state of our science. The great fluctuations going on within the solar mass tend to mask the fundamental law until it has been derived, at least approximately, by simpler methods. But the evidence is very positive that the equatorial period of 26.68 days is the shortest one actually prevailing in any portion of the mass of the sun.

[16] See Eclipse Meteorology, pages 70 and 71.

CLIMATOLOGY OF COSTA RICA.

Communicated by Mr. H. PITTIER, Director, Physical Geographic Institute.

[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope the rainfall was generally less than the average, although enough to cause numerous slides along the few railways to the western coast. In San José pressure and temperature were above the normal and relative humidity slightly under it. Rainfall almost normal and unequally distributed through the month. Sunshine one hundred and seventy-nine hours against one hundred and thirty-six. The marked alternation of hot sun and violent showers caused a good deal of damage to the coffee crop, part of which has thus been "frozen" (helado). On the Atlantic

side rainfall was almost everywhere moderate, although a few slides were reported from the C. R. Railroad in the valley of Reventazon.

Notes on earthquakes.—October 5, 2h 13m a. m., slight shock NE-SE., intensity II, duration 13 seconds. Also reported from Tres Rios.

A STUDY OF THE SUMMER FOGS OF BUZZARDS BAY.

By Mr. FRANK W. PROCTOR, dated Fairhaven, Mass., October 25, 1903.

Fog is moderately frequent in summer over Buzzards Bay on the south coast of Massachusetts. It occurs irregularly, without apparent system, and lasts for periods varying from a few hours to several days. There are no obvious weather changes immediately preceding the visitations of these fogs which might suggest their cause. The irregularity of their occurrence and duration make them an interesting study.

North of Cape Cod, in Massachusetts Bay, the water of the ocean quite to the shore is notoriously chilly; the fogs are popularly attributed to the cooling of moist air from the Gulf Stream by the Labrador current along the coast. But on the southern shore of Massachusetts the water is so much warmer that ocean bathing is comfortable in summer and there is little to suggest an arctic current.

Radiation, or ground fog, is rare here at this season, and breezes from the land are seldom cool enough to condense the vapor rising from the warm surface water of the bay. The fogs that commonly occur here in July, August, and September usually come with southwesterly winds, which are the prevailing winds of summer. These winds blow daily with much regularity, augmented by the sea breeze, and interrupted only by occasional errant highs and lows. But only a small percentage of these southwesterly winds, coming in cool from the ocean, are attended with fog, though the high temperature of the shallow waters of the bay and sounds, and the large vapor content of the lower air would seem to constitute conditions favorable to local condensation.

Every one knows that fog is condensed aqueous vapor. The requisite degree of saturation may be caused either by an increase of vapor pressure, or by a reduction of the temperature or by both in combination. In the absence of observations with thermometer and hygrometer it is impossible to know in what proportions these two factors contribute to produce a fog.

To fully understand the phenomenon of fog formation it is necessary to know the cause of the reduction of the temperature, and the source of the vapor increment. Since the cooling may come from radiation, conduction, adiabatic expansion, or mixture with cold air from elsewhere, and the added vapor may come from local evaporation or from moist air currents, it is not always a simple matter to determine how a fog has been formed. The problem becomes still more difficult when the fog to be studied has been blown inland from the sea where little is known of the mean conditions of water temperature and air moisture, and less concerning their daily fluctuations.

Moreover in most places fog occurrence is not periodic, but is so irregular as to be apparently without any system.

The Bay of San Francisco furnishes a particularly interesting case of periodic sea fogs which are thus described by Prof. A. G. McAdie in the MONTHLY WEATHER REVIEW, July, 1900, p. 284.

> With almost clocklike regularity in the vicinity of the Golden Gate on summer afternoons the velocity of the wind rises to about 22 miles per hour and through the gate comes a solid wall of fog, averaging 1500 feet in height, and causing a fall in the temperature to about that of the sea, namely 55°;[1] 1500 feet above, the air is clear and 20° or 30° warmer.

The fog photographs accompanying the text in Bulletin 31 are remarkably beautiful. In the interesting Fog Studies which are devoted to the consideration of these San Francisco Bay fogs,[2] Professor McAdie concludes:

> It is more probable that condensation is the result of the sharp temperature contrasts at the boundaries of certain air currents having different temperatures, humidities, and velocities, and that the contours of the land play an important part in originating and directing these air currents. The summer afternoon fogs of the San Francisco Bay region are then probably due to mixture more than radiation or expansion.

The summer fogs of the east coast of Massachusetts have been studied by Clayton. He concludes that they are due to the flowing of a warm, damp, air current from the south over a very cold westward current off the water.

> Intermixture of these two currents goes on until they are churned to the bottom.[3]

Neither of the foregoing explanations of fog formation seems to suit the case of the summer fogs of Buzzards Bay. Here there are no hills or mountains as around San Francisco, and there is no crossing of air currents as observed by Clayton on the east coast of Massachusetts.

On fog days both the upper and lower winds blow from substantially the same direction, viz, southwesterly.

In order to study these fogs, the writer, during the summers of 1901 and 1902, made tri-daily observations of temperature, moisture, barometric pressure, wind direction, and velocity, and noted every case of fog formation, except when asleep at night. The station of observation is on Sconticut Neck, which extends southward into Buzzards Bay on the east side of New Bedford Harbor.

It early became apparent that there is a relation between the air pressure and the appearance of fog, and the completed records for the two seasons show that there was no instance of fog when the controlling conditions were anticyclonic. This, in part, explains why these fogs as a rule form only when the wind is southwesterly and not when equally cool ocean winds come in from southeast and south. As long as the winds come from southeast and south the conditions are at this season usually anticyclonic, and the air is too dry for fog. By the time the wind has veered to southwesterly the pressure and circulation have usually become either normal or characteristic of an approaching cyclone.

In summer there is usually a haze over the water which looks like an inland summer haze, but here it is evidently of aqueous origin, for it is found when the winds are from seaward. It is of variable tenuity, but in ordinary fair weather it is generally dense enough to make the bluffs of the Falmouth shore, 11 miles across the bay, invisible from this station. It is in fact thin fog, though we are not accustomed to call visible aqueous vapor in the air fog until it is dense enough to eclipse objects near at hand. In making entries of fog observations it is often difficult to decide whether this veil over the water should be called fog or haze; one grades into the other insensibly.

The descending dry air of a passing anticyclone always dissipates this haze, leaving the air beautifully transparent, and brings clearly to view single houses on the Falmouth shore. The contrast is very striking. At such times the sky is sometimes entirely overcast with high stratiform clouds, mostly strato-cumulus, apparently showing that the descending air is confined to the lower strata. This entirely clear condition of the air is always of short duration. The haze persistently returns, and is present much the larger part of the time. The psychrometer also shows that the normal condition on shore here during July, August, and September is one of high absolute humidity favorable to fog formation, occasionally and briefly interrupted by anticyclonic dry air, but ordinarily the amount of vapor falls a little too short, and the temperature holds a little too high to permit the intense condensation called fog. For the two seasons, during the periods of observation, the percentage of foggy days in the ordinary sense was 21.5. This normal condition of high humidity, however,

[1] Weather Bureau Bulletin No. 31, p. 32.

[2] Weather Review, August and November, 1900, and January, 1901.

[3] Weather Bureau Bulletin No. 31, p. 35.

is favorable for conserving any fog that may be translated hither.

It is customary to speak of saturation as a critical condition depending upon a vapor pressure which is constant for a given temperature and must be reached before condensation can occur, and which if exceeded is always followed by condensation.

Under this theory it is difficult to account for the presence of the watery haze that is usually found over the bay in summer, even with low relative humidities.

The persistent aqueous haze over the bay with winds from seaward, seems to indicate not only that the saturation temperature is different for different kinds of nuclei, but also that under ordinary conditions the variety of suitable nuclei is large enough to make condensation a gradual process rather than a catastrophe at a certain critical vapor pressure. This haze was observed with a southerly wind and with a relative humidity on shore as low as 52 per cent by sling psychrometer. The difference between the shore humidity and that over the bay can not be large, for where the observations were made the neck of land is only about one quarter of a mile wide, with $2\frac{1}{4}$ miles of water on one side and 11 miles on the other.

In general the transparency of the air increases and decreases inversely with the vapor pressure and the relative humidity, as shown by the psychrometer, but the changes of opacity do not follow with equal step either the dew-point or the relative humidity. In a few cases the divergence is notable. In the case cited the air was hazy, with a relative humidity of 52 per cent, and at another observation it was clear at 85 per cent. Whenever the air was clear, with high humidity, absolute or relative, the conditions were unusually anticyclonic or the temperature low. Occasionally the transparency increased with increasing relative humidity, and sometimes, though less frequently, with a rising dew-point.

Single cases of the occurrence of transient aqueous haze or denser fog, when the relative humidity by the psychrometer is less than 100 per cent, can be accounted for by mixture of saturated foggy air with air of lower relative humidity. If the mixture is nearly saturated the fog will evaporate slowly.

But it is unlikely that the persistent haze mentioned is caused in this way; for it would require a region to windward with nearly continuous fog, which has not been observed.

Generally fog is not a condition of complete saturation of the air, but a saturation of certain foci with drier interspaces. The sling psychrometer showed a relative humidity of 100 per cent only twice during the two seasons with 54 total cases of fog. The delicate adjustment of moisture and temperature conditions accompanying the formation and dissipation of fog, or the effect of dust or other nuclei for condensation are shown by the fact that fog is sometimes seen to thicken, dissipate, and even disappear, under stationary conditions of dew-point, temperature, and wind, when the temperature is read to half degrees and the dew-point computed from tables with half degree intervals.

The rate of increase of the vapor pressure after the passing of an anticyclone is extremely variable. The dew-point has been seen to rise 20° within twenty-four hours. At other times the absolute humidity might be a week in making the same increment. In order to readily see what changes of temperature and dew-point usually precede the appearance of fog, the temperature and dew-point observations were plotted and curves drawn. It at once became apparent that the antecedent conditions are a simultaneous rise in the dew-point and a fall of temperature.

Evaporation from the surface of the warm, shallow waters of the bay and sounds suggests itself as a possible source of the vapor increment, and the lower temperature of the ocean surface outside of the islands as the source of the cooling. But on reflection it is seen that an increase of vapor pressure due to local evaporation would not be so sudden as the rise of the dew-point curves just prior to the appearance of fog, and that it would take but a short time for an inshore wind to blow away the accumulated excess of vapor from these limited regions of warm water. Evaporation would not go on fast enough to supply sufficient vapor for a fog lasting for days with a continuous southwesterly wind. The further difficulty arises that this would not account for the intermittent character of the cooling which precedes the fogs, for the cool sea breeze comes in almost daily.

Accordingly the scene of inquiry must be shifted seaward. A comparison of the fog records of the Vineyard Sound Light-vessel (lying 16 miles to windward, south-southwest) on fog days; of the Gay Head Light-house ($16\frac{1}{2}$ miles to windward, south), and of the Block Island Southeast Light-house (42 miles to windward, southwest), with the shore observations, shows that these offshore stations, almost without exception, had fog on the days when it was observed on shore, and also on many other days when it did not appear on shore. Evidently then the fogs are formed some distance at sea and are brought ashore by the winds. This view is also confirmed by the sharp rise in the dew-point curves just prior to fog occurrence while the temperature curve is descending. As might be expected the curves show that in general (when free from the drying influence of high pressure areas and of winds from the interior) the vapor pressure rises with the temperature. But the sudden increase of absolute humidity with lower temperature indicates that the cool inflowing foggy air must at some time earlier have been warmer than the shore air which it displaces in order to have accumulated the extra moisture. To find water (and therefore the lower air) warmer than that of the shoal waters of the coast it is necessary to go many miles out to sea.

The North Atlantic Pilot Charts of the United States Hydrographic Office show that ocean fogs occur throughout the year over the shallow waters extending from the shore out to the 100-fathom curve all along the coast from Hatteras to New Foundland, and thence eastward in a narrow belt across the Atlantic. Off the coast of the Southern States the 100-fathom curve runs substantially parallel with the shore line about 85 miles distant. From Virginia the distance gradually widens to 105 miles south of Cape Cod and to 180 miles south of Newfoundland, where the curve turns sharply southeastward and off Cape Race is 300 miles from shore, being there the outer boundary of the Grand Banks.

The area of the fog belt and the frequency of occurrence vary with the season, but being greatest in June and least in February. To the westward of the sixty-sixth meridian, which runs near Cape Sable, Nova Scotia, the distribution of fog reported by vessels, as shown on the Pilot Charts, corresponds very closely with actual fog occurrence up to within 1° of the shore line, in the opinion of the Hydrographic Office.

The southern limit of summer fogs off the shore of Buzzards Bay is about 125 miles distant, the region of greatest frequency being about half that distance. To the south of the bay, outside of the first one-degree belt, these charts show for June a fog frequency exceeding that observed on shore; for July and August about the same frequency as on shore, and for September less than on shore. To the southwest of the bay, whence most of the shore fogs come with the prevailing winds, the frequency, beyond 1° from shore, is greater than the shore frequency for June, and less for the rest of summer. After June the line of maximum frequency evidently moves shoreward. Sufficient observations are wanting for the 60 miles next to the shore, but that the maximum does not reach the shore is made evident by the sudden rise in the dew-point just before every appearance of fog.

The more frequent occurrence of fog in the region south and southeast of the bay than in that to the southwest would

naturally be expected to make the southeast and south winds more frequent carriers of fog to the shore than winds from the southwest. The reason why this is not the fact seems to be, in part, that the southeast and south winds here in summer are usually anticyclonic, and the downward component of motion partially dissipates the fog, and, in part, that to the southward and southeastward there are intervening islands, which tend to dry the incoming winds.

The June maximum, which is found generally along the Atlantic fog belt, does not occur in Buzzards Bay, partly because the summer monsoon has not yet become well enough developed to bring the fog in, and partly because the air over the waters near the shore and the land is yet sufficiently dry to evaporate some of the incoming fog.

Since the shore fogs of the bay are mainly blown in from the ocean fog belt, which skirts the coast of the United States and the Provinces, a study of the formation of the shore fog involves that of the main belt.

The Annals of the Deutsche Seewarte for 1897, Part IX, contain for each month of the year fog charts of the North Atlantic, west of 40° west, based upon the total number of cases of fog occurrence observed and reported by Dutch and German vessels within one-degree square for a period of twelve years from longitude 40° to 60° west (mid-ocean to Cape Breton Island), and for twenty-one years from 60° to 70° west (Cape Breton Island to Cape Cod).

The occurrence of fog in the eastern half of the Atlantic is not charted because it does not occur frequently enough to be deemed a substantial menace to navigation. This region is, however, covered by the fog charts of the United States Hydrographic Office for the months of July to December for the three years 1899 to 1901.

In the German charts there is entered in each one-degree square the whole number of observation hours and the percentage of the whole on which fog occurred. Lines of equal percentage of fog frequency are drawn through these squares to assist the eye in following the fog distribution.

It is the custom for steamships between the United States and Europe to follow in general a certain track or lane of moderate width on the outward voyage and another on the homeward voyage; consequently the weather observations are unequally distributed over different regions of the Atlantic and more cases of fog occurrence are likely to be observed within those limited belts which are traversed by the largest number of vessels. On this account care should be exercised in inferring the actual distribution of fog from the observed distribution.

Along these routes also the observed fog frequency is likely to be nearer the actual frequency by reason of the larger number of observations.

The entry of the whole number of observations in each square shows the distribution of the observations, and enables one, in a measure, to estimate the effect of unequal distribution of observations upon the lines of relative fog frequency.

The Monthly Fog Charts of the United States Hydrographic Office for the months January to June are based upon the German charts. For the remainder of the year they give the results of the observations of all vessels reporting to the Hydrographic Office for the three year period 1899–1901. In each one-degree square is entered the number of observed fog days in every hundred. There is nothing to indicate the total number of observations or their distribution.

The figures of fog frequency on the German and American charts relate to such long periods of time that the charted belt in the North Atlantic where fog has been observed extends unbroken entirely across the ocean from the United States to Great Britain. The lines of equal frequency show broadly that there is an axis of maximum actual fog occurrence lying along the coast of the United States and the Provinces inside the 100-fathom curve as far as the Grand Banks of Newfoundland, where it turns northward and eastward and crosses the Atlantic to Great Britain with a frequency diminishing rapidly after leaving the Grand Banks. The frequency also diminishes rapidly to the southward, so that on the southern edge of this belt the region of charted zero fog occurrence is within the district frequently traversed by vessels, and is not a long distance south of the axis of maximum frequency. It is the opinion of the United States Hydrographic Office that the southern limit of charted fog approximates pretty closely to the southern limits of actual fog occurrence. On the north the observations are much less numerous, and the distribution of fog in that direction is not so certain, but the frequency appears to decrease also toward the north, and there are reasons for expecting such a diminution.

The purpose of these charts is only to show to the mariner the probability of encountering fog. They give no indication of the actual distribution of fog at any instant or of the other attendant weather conditions which are needed in considering how the fog is formed.

The United States Weather Bureau collected and published monthly, in the Weather Review, current observations of ocean fog west of 40° west, from 1886 to 1895, and for nearly the whole period monthly charts of the same were published. For more than two years of this period, viz, from November 1886 to December 1888, detailed analytical summaries of the conditions attending each case of fog formation, especially with reference to cyclones and anticyclones and the resulting winds and the presence of ice on the Grand Banks, were given monthly.

From the charts and summaries it is seen that the fog belt, which is shown as continuous on the Hydrographic Office and Seewarte charts, breaks up when charted monthly into a few separate areas which from time to time extend and contract their limits, but which tend to be persistent over certain definite regions, viz, over the Banks of Newfoundland, the Sable Island Banks, Georges and Nantucket shoals, and along the United States coast southward. These loci of maximum fog occurrence are all in the comparatively shoal waters inside the 100-fathom curve, and are divided from one another by arms of deeper water extending shoreward from the adjacent ocean deeps.

On comparing the various fog charts with the charts of North Atlantic surface isotherms by Krümmel, published in Agassiz's Three Cruises of the *Blake*, it is seen that the portion of the fog belt from the Grand Banks westward is over cold water which has close alongside to the southward the warm waters of the Gulf Stream and adjoining branch of the equatorial current. The temperature gradient is so steep that over and just south of the Grand Banks there is a fall of surface temperature in September of 30.6° F. in 320 miles and in March of 28.8° in 120 miles. A sharp temperature contrast exists all along the fog belt from Hatteras to Newfoundland. East of the Grand Banks the surface isotherms bend sharply to the north and then eastward in the latitude of Newfoundland, but with rapidly increasing intervals, showing a marked decrease in the surface temperature gradient. But it is significant that the axis of maximum fog frequency continues to follow the direction of the isotherms, just as it does west of Newfoundland. This is precisely what would be found if these fogs were caused by vapor blown transversely across the isotherms and cooled by [radiation to] the water.

The Weather Review monthly summaries show that in nearly all the cases the occurrence of fog west of 40° west was attended by the easterly or southerly winds of cyclones and that the fog was denser than when the wind came from other quarters.

The observations of surface ocean temperatures by the United States Fish Commission, Coast Survey, and other occasional

observers, notably the British steamship *Challenger*, show that there is a belt of cold water lying along the Altantic coast of the United States. This belt is flanked on the outside by the warm waters brought from the Tropics by the Gulf Stream and the adjacent Atlantic branch of the equatorial current. These observations also show that the surface waters of the Gulf Stream and of the outer portion of the cold coast water are streaked with alternate warm and cold longitudinal bands, with sharp temperature contrasts at their margins. These bands are continually changing their actual and relative positions.

Lieutenant Pillsbury, in his Memoir on the Gulf Stream,[4] says there is no perceptible current flowing southward along the United States coast inside of the Gulf Stream, though the Hydrographic Office charts show traces of one, and Alexander Agassiz found at Newport, R. I., marine animal life belonging to the arctic fauna, which he says is direct evidence that the cold arctic current finds its way round Cape Cod to the opening of Narragansett Bay.

But whether it be appropriate to call this the Labrador current or not, there is no dispute that it is cold water in sharp contrast with the temperature of the water lying just outside, and, so far as temperature goes, it is a practical continuation of the Labrador current.[5]

As far south as Hatteras the 100-fathom curve is substantially the dividing line at the surface between the Gulf Stream and the cold coast waters.

The slope of the continental shelf is very gentle out to the 100-fathom curve, where it suddenly becomes steep and descends to the 1000-fathom line within a few miles. Outside of the 100-fathom line the arctic current underruns the Gulf Stream current.

We have seen that the 100-fathom curve is also substantially the southern limit of the Atlantic fog which forms over the cold shallow waters lying just north of the curve. The editor of the WEATHER REVIEW concluded that the cooling over the arctic current of warm moist air brought from over the Gulf Stream by the easterly and southerly cyclonic winds usually attending fog occurrence is the efficient cause of the condensation of most of the fog. It was apparently assumed that the moisture and cooling were sufficient in amount to produce the effect, and the question of the method of cooling, whether direct or by mixture of air masses, was not distinctly raised.

According to Krümmels charts of surface isotherms of the North Atlantic the mean temperature in September of the ocean water in the latitude and longitude of Cape Cod is 67°, and 270 miles south the temperature is 80.6°.

There are at hand no data of relative humidity over the open ocean. The average relative humidity of all the West India Weather Bureau stations for 1900 was 79.4 per cent with a mean temperature of 78.5°. Judging from this it is not likely that the vapor at the point mentioned, 270 miles south of this coast, is more than 80 per cent saturated, and the humidity of the air at 67° near the shore is considerably smaller.

But assuming a relative humidity of 80 per cent for both bodies of air there is no mixing ratio which would produce condensation, as will readily be seen by projecting the saturation curve and plotting the temperatures and humidities of the two air constituents according to von Bezold's graphic method. In order to saturate air at 80.6° temperature and 80 per cent relative humidity by mixture, the other component would have to be as cold as 55° with a relative humidity of 100 per cent.

Obviously then these fogs are not produced by mixture.

But in traversing the cold water surfaces to the northward the warm moist air from the south must be cooled by conduction and by radiation. Direct cooling is much more efficient in causing fog than cooling by mixture. Air at 80.6° and relative humidity of 80 per cent would need to be cooled only to 73° to become saturated.

It seems likely that under the conditions named, a thin stratum of the warm air just above the surface of the water would, by contact with the colder water and by the gentle stirring of its own mass caused by friction with the water surface, become cooled sufficiently for condensation, in a journey considerably shorter than 270 miles.

These conditions of propinquity of warm, moist air and cold water surface with the necessary winds to carry the vapor over the cold surfaces are found in varying degree over the entire North Atlantic fog belt. In general wherever the highest humidities and sharpest temperature contrasts are found the frequency of fog is the largest.

There is no evidence that any such crossing of moist air currents from the south over cold lower currents from the east, as Clayton observed at Blue Hill, generally attends the formation of fog along the Atlantic fog belt; the Weather Bureau fog and weather records seem to indicate the contrary.

There is no question about the accuracy of the Blue Hill observations, and they are not at all in conflict with the foregoing theory of fog formation. An overflowing current from the south would not interfere with the bringing in of fog from the Georges or Sable Island fog banks by easterly winds, and it might intensify the condensation at the bounding surfaces, but it is not easy to see how there could be any "churning" throughout the lower layer while the warmer current is on top.

There remain many cases of fog (though a small percentage of the whole number) unaccounted for. In the vicinity of the Grand Banks for the period May, 1887–December, 1888 (when the WEATHER REVIEW gives the number of fog days for each month), the winds were in the south and east quadrants of lows on 91 per cent of the fog days. Of the remaining 9 per cent, 2 per cent of the fog days had winds from the colder regions; the other 7 per cent had variable winds, wind northeast, and wind direction not stated.

For the region west of the Grand Banks the data are not specific enough for a precise computation of the ratio of north and west winds to those from the south and east on fog days. It is evident, however, that the percentage of fog with north and west winds is considerably larger in this region (west of 60° west) than for the vicinity of the Grand Banks. It is, perhaps, as much as 10 per cent.

It is noticeable that this class of cases is larger during the summer months when the tropical surface waters are farthest north; and also that these cases increase relatively to the whole number of fog occurrences where the contrasts of temperature are likely to be sharpest, though only at exceptional times during the warm months.

Fogs with these northwesterly winds usually occurred immediately following the passage of lows to the eastward. It is not easy to conjecture exactly how the observed conditions conspired to produce this class of fogs. The editor of the WEATHER REVIEW attributed the condensation to "the contact between cold northerly winds to the west of lows and the warm, humid air from the Gulf Stream that had been collected in that region by the winds preceding storm centers."

The winds of a cyclone usually veer gradually, so that there is little opportunity for air from any special region within the influence of the storm to accumulate in any other region, and in general there is in a low no well-defined bounding surface separating bodies of air having marked contrasts in temperature and moisture. When a depression takes the V or trough shape the contrasts are sharp, and it is conceived that for a short time after the shift of wind to the west and north the conditions would be favorable to fog condensation, but they would be transient.

[4] Appendix 10, United States Coast and Geodetic Survey Annual Report, 1890.

[5] See Agassiz's Three Cruises of the *Blake*.

That the conditions attending fog formation during this shift of wind are exceptional and pronounced is evident from the fact that in nearly all cases of fog formation attending the passage of a cyclone the fog is dissipated upon the shift of wind to the west and north.

According to von Bezold:

> The fog above warm, moist surfaces, under the influence of colder air, therefore, especially the fog over the sea in the cold season of the year or during the occurrence of cold winds, may be considered as originating by mixture.[7]

But for the authority of the eminent physicist, one would be inclined to question whether fog banks of considerable depth and permanency are formed over the ocean in this manner.

In air mixtures the cooler component dries the moister one while it cools it. The difference in temperature may be large enough to overcome the drying effect; but the cloud formed is likely to be transient, as seen in the momentary condensation of the breath on a frosty morning. Sufficiently large contrasts in temperature are usually wanting under ordinary weather conditions; and there is the difficulty of mixing two large, unconfined bodies of air of different temperatures and humidities to be overcome.

Notwithstanding some discontinuous motion at their meeting surfaces two contiguous air currents having different directions or velocities slip by each other with much ease and are little inclined to mix. Moreover in the reported cases of fog banks the existence of such counter currents is not usually noted.

In case of a cold wind blowing across the surface of warm water, there is apparently little or no condensation by mixture of air masses. The process, as observed at this station by the writer, seems to be somewhat as follows: The vapor evaporates at the warm water surface directly into the cold air current above, and is immediately condensed. By reason of its smaller specific gravity, due either to the vapor or to warmth from the water or both, the thin cloud of fog rises slowly, mixes with the drier air, and is swept to leeward, evaporating in whole or in part. Thus, the effect of whatever mixture occurs in such cases is to dissipate rather than to condense the fog.

Evidently the amount of vapor momentarily evaporated is too small to create much of a cloud unless it be allowed to accumulate, and this is prevented by the wind. The more moderate the breeze the more vapor will be taken up per unit volume by the overflowing air. But in any event the volume of moist air must be small in comparison with the drier air above, and it will, therefore, be quickly evaporated if the two become thoroughly mixed.

The details of the conditions attending the formation of the fogs with north and west winds are not sufficiently given in the Weather Review summaries to permit confident conclusions to be drawn as to the precise operation of the causes which produce the fog cloud. The volume and persistence of these cold-wind fogs are not stated, except that they are not so dense as the fogs which form with south and east winds.

To hazard a conjecture, it is, perhaps, not impossible that this class of fogs is formed something as follows: The water over the shoals being for some reason abnormally warm, the customary condensation of fog does not take place while the winds are from a southerly direction. These warm winds raise the temperature of the water still higher, so that when the wind shifts to northwest it finds evaporation uncommonly rapid. If the winds from this quarter should happen to be exceptionally cold, all the conditions would favor condensation near the surface which might be sufficient in amount to resist for a time the drying which usually attends northwesterly winds.

In the case of the San Francisco Bay fogs it is difficult to understand how mixture and condensation at the bounding surfaces of a moving body of air 1500 feet deep and several miles wide could be sufficient in amount to make so large a volume of fog, and to keep it replenished and undiminished in size, while it is being continually swept away at the velocity of 22 miles an hour.

The history of the North American fog belt suggests the possibility that an inquiry into the temperature conditions of the coast and offshore waters of California might throw light upon the fogs of San Francisco Bay.

There remain to be considered a few cases of fog of another class, viz, high barometer fogs. It was noted above that during the two summer seasons of the Buzzards Bay observations no case of fog was found with a high barometer, but the Weather Review summaries show a few such cases on the offshore banks. They are all in colder months of the year, some with east and south winds, some with west to north winds, and some with variable winds. The details are mostly lacking.

The small number of fog occurrences with high pressure shows that under exceptional conditions the horizontal components of the winds may be so much more important than the vertical components that the air may be cooled by horizontal translation enough for condensation in spite of the drying effect of a moderate downward movement.

The main factors in the causation of the North Atlantic fog belt seem to have been settled by the investigations of the Weather Bureau above mentioned. They are summed up in Weather Bureau Bulletin A thus:

> The fogs are apparently due to the precipitation of aqueous vapor contained in warm air from over the Gulf Stream, which is drawn over the cold surface of the arctic current and ice fields by southerly winds of the eastern quadrants of areas of low pressure.

This leaves unexplained some of the attending local phenomena, notably the division of the fog belt into patches of maximum frequency tending to be persistent over certain regions (the Grand Banks, Sable Island Bank, Georges and Nantucket shoals), but sometimes shifting their locations and usually undergoing continuous changes in size.

On the Grand Banks, by reason of the presence of the narrow Labrador current close to the shore and the floating ice, the sharpest surface temperature gradients of the Atlantic are found, and this abundantly accounts for the persistent formation of the fog in this region.

There is a similar though less strong tendency of fog maxima to persist over the Sable Island Bank and the Georges and Nantucket shoals; and it is not at once obvious what makes the waters of these shoals colder than the water in the straits or deeps of the ocean which extend shoreward between these banks, though this is doubtless the fact. Major Dunwoody says it is due to the "forcing to the surface of the cold, deep-flowing waters of the arctic current;" but he does not explain the process. Lieutenant Pillsbury thinks the low temperature over the shoals "is probably due to the cold water from the outside being forced on the shore by the advancing tidal impulse."[8] But why the warm surface water does not come in with the tide as well as the cold waters from the deeps is not explained, nor how the tidal wave is transformed into a current in waters "from 40 to 80 fathoms" deep. The course of the Labrador current along the coasts of the Provinces and eastern New England would seem to sufficiently account for the low temperature of the water over the continental shelf, the chief question being as to the cause of the higher surface temperatures frequently occurring in the deeps which divide the shelf into separate banks and shoals.

On a schematic chart of the Deutsche Seewarte, showing the currents in the Gulf of St. Lawrence and vicinity, the main

[7] Translated by Abbe, page 285 of his Mechanics of the Earth's Atmosphere.

[8] Gulf Stream Investigations, p. 596.

current in Cabot Strait between New Foundland and Cape Breton Island is southward; but an eddy or countercurrent is shown running back northward along the western coast of New Foundland and then recurving into the main outward current from the Gulf. This eddy current would carry warm water northward, making a bight in the surface isotherms, and thus separating the Grand Banks from the Sable Island Banks by a tongue of higher temperature. Possibly there may be a circulation of water in the Bay of Maine whereby currents of warm water divide the Georges Shoals from the Sable Island Bank on the east and from the Nantucket Shoals on the west.

The deep narrow arms of the sea extending into the Bay of Maine and the Gulf of St. Lawrence from the south between these banks and shoals are suggestive of the possibility of such currents, and their effect would be to divide the waters of this region into thermal districts corresponding in general with the observed loci of fog maxima.

East and west the distribution of fog ought to follow pretty closely the variation of water temperatures, when the winds are southerly. But north and south the distribution will depend largely upon the winds which carry it along.

If the division of the fog belt into local maxima over the Nantucket and Georges Shoals and the Sable Island Bank is due to currents in the straits or narrow deeps between these shoals, the currents can not be continuous in time or constant in direction; for fog frequently extends across these deep straits making an unbroken belt; and in some months there is a maximum of fog occurrence directly over the large deep in the bays of Maine and Massachusetts, and also one over Cabot Strait deep. This would indicate a cessation or a reversal of the currents at times. The data at hand are not sufficient to show whether the shifting of fog from the shoals to the deeps and back again is systematic. In addition to the tendency of the fog belt to break up east and west into local areas which are not constant, except over the Grand Banks, there is a persistent tendency of the frequency to increase to the northward, the lines of equal percentage of frequency running east and west, with the line of maximum frequency skirting the coast of Maine and the Provinces close inshore. The Seewarte charts show an increase of frequency shoreward from 10 to 50 per cent in April, 10 to 60 per cent in May, and 10 to 70 per cent in June. In July the line of maximum frequency is somewhat offshore, decreasing both to the north and to the south. In every other month the percentage increases going north.

Undoubtedly the water is coldest where fog is most frequent; but the cause of the shifting about of the coldest water areas is not apparent.

In the opinion of Alexander Agassiz[9] the longitudinal cold bands at the surface of the Gulf Stream current "have no regularity, and only represent at any given moment the unceasing conflict going on between layers of water of different velocities and of different temperatures." Here the arctic current directly underruns the warm water from the Tropics. How far inshore the conflict extends can not be stated; but observations of ocean surface temperatures in the fog belt show considerable changes from day to day, and differences of several degrees on the same day between stations near each other.

Most fog banks are shallow, and the winds which contribute to their formation need to be substantially horizontal for considerable distances. The frequent lack of such horizontal air movement due to vertical components of motion (which are usually unnoticed), and the want of uniformity in the temperature and moisture relations of the offshore waters explain the apparent capriciousness of the Buzzards Bay summer fogs, which so impress the casual observer.

[9] Three Cruises of the *Blake*, p. 254.

Acknowledgments are due to the United States Commission of Fish and Fisheries, the United States Coast and Geodetic Survey, the United States Hydrographic Office, the United States Weather Bureau, and Mr. F. Lawrence Briggs, mate of the Vineyard Sound lightship, for data and references to sources of information.

A PHOTOGRAPH OF LIGHTNING AT HAVANA, CUBA.

By W. C. DEVEREAUX, Assistant Observer Weather Bureau, dated October 19, 1903.

I have the honor to forward a photograph of lightning taken in this city September 16, 1903, at 10:28 p. m. (Havana time), by Señor Jose Gomez, a professional photographer of this city. Señor Gomez states that the shutters of his camera had been open about five seconds when a very vivid flash of lightning compelled him to shut his eyes, and at the same time pressed the bulb which closed the shutters. He thinks that the two prominent streaks of lightning, shown in the picture, occurred either exactly together or within a fraction of a second of each other.

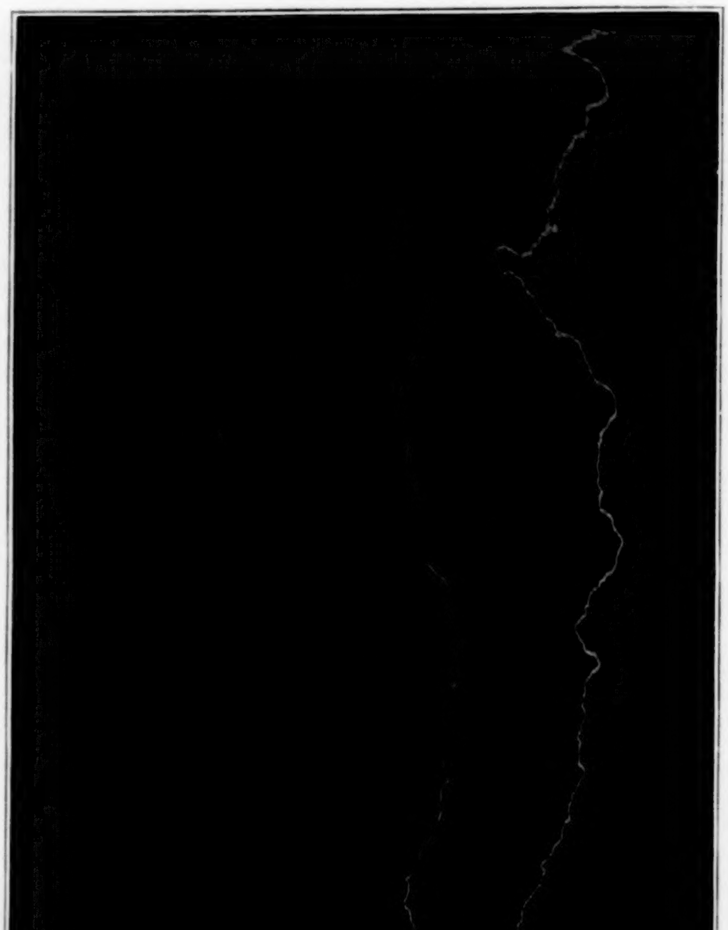

FIG. 1.—Two simultaneous flashes of lightning.

The following is the part of my journal which describes the storm of that evening:

Two very severe thunderstorms occurred late in the evening and at the same time. Thunder was first heard to the east at 9:35 p. m.; the center of this storm seemed to pass slightly to the northeast of the station, moving northwest. The first thunder of the second storm was heard to the southwest at 9:50 p. m.; the center of this storm seemed to pass over the western part of the city, moving north. The thunder from both storms was very loud from 10:30 p. m. to 10:50 p. m.; a light

rain began at 10:35 p. m.; about 10:50 p. m. the two storms seemed to meet over the sea to the north-northwest of the city, and from that time until after 11 p. m. the discharges of lightning to the northwest were very vivid and numerous, but the thunder was not as loud as it had been during the previous ten or fifteen minutes; heavy rain began at 10:57 p. m.; the wind, which had been light and generally east during the evening until 10:45 p. m., reached a maximum of 32 miles from the northeast between 10:55 p. m. and 11 p. m.

Most of the studies of lightning hitherto published have emanated from northerly regions. We are glad to publish this article from within the Tropics, where lightning is supposed to be most intense, and where special opportunities offer for studying its spectrum, its structure, and its physical peculiarities.—*C. A.*

E. O. NATHURST.

Biographical note by H. C. BATE, Local Forecaster and Section Director.

Mr. Einer Oswald Nathurst, Voluntary Observer, Tennessee section of the Climate and Crop Service of the Weather Bureau, died at his home in Tracy City, Tenn., Thursday, October 15, 1903, aged 69 years.

Mr. Nathurst was a native of Stockholm, Sweden, and came to America in 1854. For many years he was bookkeeper in Nashville, Tenn. In 1865 he went to Tracy City, and entered the service of the Tennessee Coal, Iron, and Railroad Company, and from that time until his last illness was connected with that company.

For the past seven years he had been a faithful and valued member of the corps of voluntary observers of the Tennessee section of the Climate and Crop Service. His work was characterized by a remarkable record of promptness and accuracy.

He was a man of very considerable scientific attainment in many branches, particularly in geology and mineralogy, which made him especially valuable, both as superintendent of the great coal mining industries at Tracy City, and also as a voluntary observer in the Weather Bureau, and the Service sustains a great loss in his passing away.

RECENT PAPERS BEARING ON METEOROLOGY.

Dr. W. F. R. PHILLIPS, Librarian, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

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Strutt, R. J. Radium and the Sun's Heat. P. 572.
Everett, J. D. Rocket Lightning. P. 599.
MacDowall, Alex. B. Our Winters in Relation to Brückner's Cycle. P. 600.
Rotch, A. Lawrence. The New Bishop's Ring. P. 623.
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Shaw, W. N. [Review of] Handbook of Climatology. Part 1. General Climatology. By Julius Hann. Translated by Robert de Courcy Ward. Pp. 3–4.
Langley, S. P. Variation of Atmospheric Absorption. P. 5.
Fowler, A.; Chree, Charles. Solar and Magnetic Disturbances. P. 6.
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Mill, Hugh Robert. Weather Changes and the Appearance of Scum on Ponds. P. 7.

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Ellis, William. Mean Rainfall. P. 162.
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—— L'émanation radio-active de l'air atmosphérique. [Note on memoir by Elster and Geitel.] Pp. 389–390.
Debrowolski, A. Quelques idées sur la forme et sur la structure des cristaux de neige. Pp. 391–403.
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Moissan, Henri. Sur le dosage de l'argon dans l'air atmosphérique. Pp. 600–606.
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Woeikof, A. Referate über russische Forschungen auf dem Gebiete der Meteorologie. Pp. 451-458.
—— Dr. Friedrich Draenert. P. 458.
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NOTES AND EXTRACTS.

SUN SPOTS AND THE WEATHER CONDITIONS ON THE EARTH.

In a recent interview Professor Bigelow said:

The connection between the outbreak of sun spots and the weather conditions on the earth has been discussed for many years with very different conclusions. A certain class of students contends that there is a distinct connection between the weather conditions and the number of sun spots from year to year, while others maintain that such connection is really insignificant.

The fact is that the direct comparison of the weather with the sun spots does not do justice to the scientific side of the problem, because the sun exhibits an outflow of energy in other ways than by the number of visible sun spots. Such other ways are the prominences or hydrogen flames, the number of faculæ, the extent of the corona, and the variation of the earth's magnetic field, as shown in the aurora and in the movements of the magnetic needles in the different parts of the earth.

The sun spots are a comparatively sluggish or insufficient register of the effect of the sun's internal action, especially as compared with the prominences or the magnetic field. Oftentimes there are sun spots without corresponding weather phenomena, or there may be active weather conditions without spots, but taking the statistics broadly from year to year it has been proved conclusively that the variation of the activity of the sun, as shown in its prominences or in the earth's magnetic field, does have a corresponding change in the variation of the annual temperatures and pressures in all parts of the earth.

The problem becomes very complicated for the meteorologist because the change in the sun's action first stirs up the circulation of the whole atmosphere of the earth, and this in its turn produces storms more or less vigorous in different parts of the earth; so that the occurrence of a storm at any given place must be referred back to the sun's action more or less indirectly through a long chain of circumstances. These are at present only partially understood, but rapid progress is being made in the examination and classification of the facts. We are looking now to a study of prominences and the magnetic field as promising more direct and valuable information regarding weather conditions than the sun spots. It is like trying to find the most sensitive pulse in a circulating system.

WEATHER BUREAU MEN AS INSTRUCTORS.

According to the News, Macon, Ga., October 22—

There are not less than thirty schools in and around Macon which are using the weather reports as charts for instruction. The teachers say that there is nothing which is so helpful in teaching physical geography as the information and the maps that are furnished by the Bureau. Ample opportunity is given the little ones to study the movement of the clouds, the variations in temperature, and the changing and shifting of the elements in a way that impresses the young mind and affords a practical illustration in fact to the truths that have been taught in theory.

Frequently classes from the city school system pay Mr. Weeks a visit for the purpose of examining more closely into his methods and instruments used in making his forecasts.

Mr. Edward A. Beals, District Forecaster, Portland, Oreg., reports that the second section of the high school class in physical geography visited the local office of the Weather Bureau on October 19 and was instructed by Assistant Observer John Grover.

It is announced that on December 18, Mr. Weston M. Fulton, Local Forecaster, Knoxville, Tenn., will deliver a public lecture on meteorological subjects at Chattanooga. At the close of the lecture a collection will be taken up to raise funds for the meteorological department of the high school.

As many high schools and other institutions in the country have been disappointed on finding that the Weather Bureau has no authority to loan or give apparatus for educational purposes, we commend to them this new method of raising funds needed to purchase the meteorological equipment.

Mr. Charles Stewart, Observer of the Weather Bureau, reports a lecture delivered by himself before the Spokane Science Club November 10. This was one of numerous lectures under the general title of "Weather Changes and their Causes," that he has delivered to various audiences; sometimes to the pupils of a primary grade school, sometimes to the advance pupils of a high school, and at other times to the general public.

In the present case Mr. Stewart reports that he began with some remarks on the composition of the atmosphere; then a Weather Bureau barometer was exhibited and the principle underlying the action of the barometer was considered. The prevailing upper westerly winds were cited as the cause of the easterly drift of the weather changes in our latitudes; a chart of an ideal cyclone was exhibited and the characteristics of pressure, winds, temperature, cloud and rain area, etc., within a cyclone noted; then the characteristics of the cyclone were considered in detail, involving some consideration of the cyclone as of convectional origin, and some of the properties of a gas when expanding or being compressed; the theory of cyclones was demonstrated by blackboard diagrams, together with diagrams relating to tornadoes. After the foregoing preliminaries, a large map of the United States was exhibited, and on this map the climatological divisions of the United States were noted and the average routes of cyclones traced. Then the course of an imaginary cyclone was traced from the Pacific to the Atlantic, and the resulting weather changes, as modified by topography, were pointed out; this involved a notice of warm waves, chinooks, cold waves, and tornadoes. The cause of the limitation of tornadoes to the eastern portion of the country was also considered and forecasting was touched upon.

Mr. L. M. Pindell, Observer Weather Bureau, Chattanooga, Tenn., reports an afternoon devoted to the local high school class in meteorology on October 9.

Prof. Alexander G. McAdie reports that on October 19, forty pupils of the Adams Cosmopolitan School of San Francisco visited the Weather Bureau office of that city and spent about one hour, receiving the usual instruction and explanations relative to Weather Bureau work.

SUN-SPOT PERIODS IN METEOROLOGY.

In the Meteorologische Zeitschrift for October, 1903, Vol. XX, p. 478, Dr. A. Nippoldt, jr., states that the numerous researches published by Prof. J. N. Lockyer and his son, Dr. W. J. S. Lockyer, during the past twenty years, have developed new ideas concerning the relation of sun spots to terrestrial magnetism. The latest memoir, Proceedings of the Royal Society, 1903, vol. 71, pp. 244–250, maintains that it is the solar protuberances and solar faculæ, not the solar spots, that appear to vary with the important magnetic disturbances. The great terrestrial disturbances, or the exceptional disturbances, decrease in proportion as the solar phenomena occur in higher latitudes, namely, more distant from the solar equator, whereas the regular periodic variations in terrestrial magnetism seem to be more especially influenced by the activities near the solar equator. Lockyer explains this on the assumption that the increase of faculæ and protuberances causes an increased variation in the energies on the sun's surface, and, since the total area of faculæ and protuberances is much larger than the area covered by the spots, therefore it would seem plausible that the former should have a greater influence than the latter. The occurrence of spots is, therefore, an unimportant concomitant of the condition that causes magnetic disturbance.

Dr. Nippoldt adds that Marchand had also endeavored to show that the faculæ are the effective or productive solar phenomena. (See the Proceedings of the International Meteorological Congress, Paris, 1900.) These views of Lockyer are supported by the view adopted by other investigators, to the effect that the gaseous flames or protuberances of the sun cause a transportation of elastic energy toward the earth, and thus determine the variations of our own magnetism, electricity, and auroras. From all this it seems to follow that the sun spots are by themselves very poor representatives of the actual effective forces of disturbance.

In the American Journal of Science and Arts, November, 1870, 2d series, Vol. L, p. 345, the present Editor of the MONTHLY WEATHER REVIEW published the results of one of his earliest investigations on the connection between terrestrial temperature and solar spots. Among other things he made a special study of temperatures observed on the Hohenpeissenberg, as published in the supplementary Vol. I of the Annals of the Munich Observatory. This series extends from 1792–1850. The thermometers were observed daily at 7 a. m., 2 and 9 p. m. The annual mean temperatures deduced from all the observations was compared with the table of relative sun-spot numbers given by Wolf, and it was shown that a change of 100 in the sun-spot number (which is very closely the range between the years of least and years of greatest spot frequency) corresponds to a change of 0.789° R., or 0.986° C., in the mean annual temperature. A similar comparison between the sun-spot curve and the temperatures observed at 2 p. m. showed that a change of 100 in the spot number corresponds to a change of 0.801° R., or 1.001° C., in the observed temperature. The outstanding discrepancies of the individual annual means were so greatly reduced by making allowance for this sun-spot influence that the so-called probable error of these values was only 0.204° R. in the first case and 0.221° R. in the second. There was, therefore, every reason to believe in the reality of a general variation in the earth's mean annual temperature and in the solar radiation running parallel with the variations of the sun spots and having a range of 0.8° R., or 1.0° C., for a total range of 100 in Wolf's relative sun-spot numbers. The larger the number of spots the smaller the mean annual temperature. The author also found "plain indications of a period of about 50 or 55 years' duration, probably identical with five sun-spot periods or Wolf's 56-year period." He adds that "the solar spots are but an imperfect index to the periodic changes in the solar radiation, these changes being apparently more intimately and directly connected with tides in the cool atmosphere surrounding the solar photosphere." Further investigation of this subject was delayed by the Editor's removal from Cincinnati to Washington, and the investigation was subsequently carried out more elaborately by Dr. Koeppen, of the Seewarte at Hamburg, who was able to show that an increase of sun-spot numbers coincided with a prompt diminution of temperature in the equatorial regions, but with more complex effects as we proceed toward either pole. According to Koeppen, an increase of 100 in Wolf's sun-spot numbers corresponds to a decrease of 0.54° C. in the mean annual temperature of the whole tropical zone.

On page 263 of the Meteorologische Zeitschrift, August, 1873, Koeppen says:

> The two phenomena, sun spots and tropical temperatures, are evidently connected, but what the nature of this connection is can not at present be definitely determined. But it is clear that the sun spots do not act as a partial eclipse by darkening one portion of the sun's disk, while the remaining portion continues to radiate as before. Since the temperature of the earth's surface is a summation result of solar radiation, therefore the change in this latter should necessarily occur later than the change in the intensity of radiation; but as the number of sun spots and probably also the total area of the spots attains a minimum and maximum after the corresponding maximum and minimum in the temperature of the tropical stations. * * * It appears to me that the data here presented justify the assumption that the temperature of the sun's surface, for some unknown reason, is highest one or two years before the minimum of sun spots.

In the MONTHLY WEATHER REVIEW for August, 1903, pages 371–373, we gave the results of the most recent publication on this subject by Professor Angot, according to whom the probability is 7 to 1 that an increase of 100 in the relative sun-spot number is accompanied by a diminution of 0.33° C. in a mean annual temperature of stations within the Tropics. This is not very different from the results obtained by Koeppen for tropical regions, and by the present Editor for Hohenpeissenberg. Now the irregularities in our mean annual temperatures must be considered as being due partly to variations in the heat received from solar radiation, and partly to the irregularities of wind, cloud, rain, fog, etc., and it becomes desirable to obtain a clear idea of the relative importance of these solar and terrestrial sources of irregularities. This may be done by the following method: On page 372 of the August REVIEW Angot gives the details of his calculations for the station at Camp Jacob on the island of Guadeloupe. He finds that the probable departure of any annual mean daily temperature from the general average is ± 0.20° C. when all sources of irregularity have full play. But if the periodic irregularities apparently due to the sun spots are allowed for, then the remaining or terrestrial sources of uncertainty produce a probable departure of only ± 0.06 °C. In other words the variations due to terrestrial atmospheric irregularities represent ± 0.06° C.; those due to the solar variations represent ± 0.19° C., and those due to both causes combined amount to ± 0.20° C. The relative importance of the solar and terrestrial irregularities is therefore as 361 to 36, or 10 to 1.

The other tropical stations quoted by Angot give smaller values for the influence of the solar variations. The long series of records at stations beyond the Tropics also show that there the terrestrial influences are greater. Indeed, Koeppen found that in the North Temperate Zone the regular changes of atmospheric circulation and cloudiness completely mask the variations of temperature in our atmosphere that appear to be due to the influence of solar variations. Our own computation for Hohenpeissenberg, 1792–1850, as above quoted, shows that the variation of any annual mean daily temperature from the average of fifty-three years is ±0.449° R. when terrestrial and solar variations are included, but it becomes ±0.430° R. when sun-spot variations are excluded and

terrestrial only remain. This shows that at this location the sun-spot influence is represented by $\pm\sqrt{(0.449)^2-(0.430)^2}=\pm0.129°$ R., whence we infer that the solar influences are to the terrestrial influences as $(0.129)^2$ is to $(0.430)^2$ or as 0.0167 is to 0.1849, or very nearly as 1 to 11. A similar computation is still more instructive if we use not the mean daily temperatures for each year, but the annual means of the temperatures observed at 2 p. m., which may be supposed to show the direct heating power of the sun with especial clearness. In this case the variation of any annual mean is $\pm0.489°$ R. when both terrestrial and solar variations are included, but $\pm0.465°$ R. when sun-spot variations are excluded, thus leaving $\pm0.151°$ R. as the result of the sun-spot disturbances, and making the midday or maximum solar influence to be to the terrestrial influences very nearly as $(0.151)^2$ is to $(0.465)^2$ or as 0.0229 to 0.2162 or as 1 to 10.

THE NOISES MADE BY PROJECTILES AND METEORS.

The existence of the atmosphere at great heights above the ground is usually said to be demonstrated by the fact that meteors or shooting stars are heated by the compression of the air in front of them as they rush along at the rate of from 10 to 30 miles per second. The heat is sufficient to burn off the surface of the meteor, making a bright light and oftentimes leaving a trail behind. The altitudes of such meteors vary between 10 and 100 miles, as shown by satisfactory observations for parallax, made by observers many miles apart.

At this great altitude the air is probably very rare; it may even be questioned whether it is dense enough to produce any great heating effect at an altitude of 100 miles. We are inclined to suspect that there may be clouds of fine solid particles revolving about the earth in this region rather than a gaseous atmosphere. The zodiacal light may be explained as the light from either a gaseous ring or a stream of particles as fine as sand surrounding the earth. A gas under no external pressure will not stay in one location; it either diffuses or else becomes a ring of independent particles.

There has been some discussion as to the ultimate origin of the noise that proceeds from a large meteor as it rushes through the atmosphere. Most observers describe the noise as similar to that of the discharge of a cannon, but followed by a long rumble like that of thunder or perhaps the rattle of musketry. The meteor moves so rapidly that we have, as it were, a straight line many miles long and a hundred miles distant from the observer which becomes the source of sound waves starting almost simultaneously from the whole length of the path. The concentration of these waves at the observer's station explains the explosive noise and the subsequent rattling, but what makes the original violent sound waves? There are four ideas as to this, all of which may be true:

1.—The meteor strikes the air so violently as to produce the same effect as when it strikes a liquid or a solid.

2.—The rapid movement of the meteor leaves a long vacuous trail, into which the surrounding air rushes and the impact of air on air starts the sound wave.

3.—The meteor revolving rapidly on its axis, striking the air a myriad of times on all sides and in all directions, produces a rapid succession of waves.

4.—The meteor is so heated by the compression of air in front that it burns and cracks, and there is a continuous sputtering as its surface particles burn up, split off, and flow away.

What are the phenomena of sound observed a short distance from the path of a projectile when going past the observer at the greatest possible speed? Can any plausible explanation of the noises that attend meteors be given, taking into consideration the fact that the greater part of their path is at such a high elevation that atmospheric pressure or density is not the thousandth part of what prevails at the earth's surface? I have heard the whistling of bullets as they passed over my head, but these do not move much faster than the waves of sound, whereas a meteor frequently moves 20 miles per second, or 100 times the velocity of sound and the noises starting simultaneously from the 20 miles of its path that is nearest to the observer, must reach his ear as one concussion.

On this subject Prof. Philip A. Alger of the United States Naval Academy, of Annapolis, Md., writes as follows:

> Although I have witnessed the firing of thousands of rounds from all sorts of guns, I can not distinctly recall the sound made by projectiles in flight as heard by one near the guns. I suppose the attention is distracted by the louder sound of the discharge; and I have never been near the path of a projectile and at the same time far from the gun itself. The sound made by a piece of shell, such as often glances from an armor plate and flies to a considerable distance, is like a shrill whistle, as I remember it; and the sound made by a large shell which for some reason has not sufficient rotation to travel smoothly point first and therefore wabbles and finally tumbles end over end, is as Lieutenant Strauss describes it.
>
> Many of the projectiles to which the inclosed letters refer have velocities as high as 2900 and 3000 feet per second.
>
> As far as meteors are concerned, it seems to me unlikely that their impact upon the atmosphere can make a sound in the way that would happen if they struck a solid or liquid. There can be no line of demarcation between the atmosphere and surrounding space, it seems to me, and the meteor will pass by insensible gradations from a vacuum into air of measurable density.
>
> I imagine the other three causes you name, and especially the rushing of the air into the vacuum formed in the meteor's path, are the true explanations.

Lieut. A. C. Diffenbach writes:

> In reply to yours of the 4th, the consensus of opinion seems to be that the nearest approach to description of the noise of the shell in flight is that of a railway train when a little distance off, so as not to hear the clatter of the rails, but simply a roar. It is very difficult to describe. It seems a little bit like some one holding a tube to your ear and giving a prolonged shout or roar into it. Of course, it has the fading away due to distance.

Lieut. John Strauss writes:

> While in the office at the Naval Proving Ground I have, of course, frequently heard the sound of passing projectiles. As the disturbed air wave reaches you, a sound is made that is about half way between a boom and a crack, and then a moment later comes the boom of the discharge. The crack is almost as loud as the boom and perhaps a little more annoying.
>
> When a large shot tumbles, the rumble sounds to those near the trajectory like that of a railroad train.

CLIMATE AND MANKIND.

Prof. R. E. Dodge, of Teachers' College, Columbia University, has written a pamphlet of 18 pages, entitled a "Syllabus of a Course of Six Lectures on Climate and Mankind."

1. Climate and Mankind: Introduction. 2. Life in Deserts. 3. Life in Temperate Lands. 4. Life in Tropical Forests. 5. Mountains and People. 6. Plains and People.

As many of the readers of the MONTHLY WEATHER REVIEW are engaged in lecturing and teaching on these subjects, we can not do better than to recommend that they send ten cents to the Teachers' College of Columbia University, New York City, and obtain a copy of this syllabus, as it certainly contains many excellent suggestions for the use of teachers of geography, among whom Professor Dodge is a leading authority.

RELIABILITY OF HIGH WIND RECORDS.

In reply to a question as to the highest recorded velocity and pressure of the wind, it may be said that it has long been recognized that the devices that were used in 1870 and earlier for measuring the force of the wind by means of the pressure on moving plates, etc., are likely to yield quite inaccurate results, especially with respect to the maximum gusts. This is owing to the unavoidable effects of the inertia of the moving

systems involved in the registration. It is quite improbable, for example, that the pressure of 90 pounds per square foot reported to have been indicated by the Osler's pressure gage at Bidston, Liverpool, March 9, 1871, was an accurate record of the force of the wind at that time and place.

Even at the present time there is a great deal of uncertainty not only as to the velocity of the wind in those cases where our instruments indicate velocities of from 50 to 100 miles per hour, but also as to the relations between velocity and pressure under these extreme conditions. This is owing to the difficulty and expense surrounding reliable experimental investigations of this problem, and also to the considerable discordance that exists between the results of the investigations that have been attempted.

The question was quite extensively studied in England by the Wind Force Committee of the Royal Meteorological Society, and numerous papers on the subject will be found in the "Quarterly Journal of the Royal Meteorological Society," since about 1888. Notes of exceptionally high wind pressures, as deduced from the results of the investigations referred to, will also be found in the recent numbers of "Symons's Meteorological Magazine."

In regard to the highest wind velocity records in the United States, it may be stated that records by the Weather Bureau type of Robinson anemometer used on Mount Washington, N. H., have frequently shown velocities ranging from 100 to 120 miles per hour. There is one doubtful record of a velocity of 186 miles per hour, but we have authentic records of 150 miles per hour. We have also a perfect record from our station at Point Reyes Light, Cal., of a long sustained velocity exceeding 90 miles per hour, with an extreme velocity of 120 miles per hour.[1] It must be confessed that we are unable to accurately interpret the indications of our anemometers at these very high velocities.

The size and inertia of the Robinson anemometer affect its records, and that too differently in gusts and in steady winds. The Weather Bureau pattern has been tested up to 60 miles per hour only, and the resulting table for converting recorded into true velocities is as follows:

Indicated velocity.	Correct velocity.
5	5.1
10	9.6
20	17.8
30	25.7
40	33.3
50	40.8
60	48.0
70	55.2
80	62.2
90	69.2

All velocities above the 60-mile limit must remain hypothetical until the apparatus has been properly standardized.

THE PHILIPPINE WEATHER BUREAU.

The Annual Report of the Director of the Philippine Weather Bureau for the year ending August 1, 1902, is addressed to the Hon. Dean C. Worcester, Secretary of the Interior, P. I., and was printed as Appendix P, pp. 663–677, of the Report of the Philippine Commission to the President of the United States. Although printed at Washington in 1902, this report reached the U. S. Weather Bureau, via Manila, only in July, 1903.

The publications of the Philippine Weather Bureau, so far as we have received them, may be classified as—

(*a*) The Annual Report of the Director to the Philippine Commission. Published in octavo as an official document of the United States Senate, at Washington, and also to be had as a separate from the Annual Report of the Bureau of Insular Affairs, under the Secretary of War.

[1] See Monthly Weather Review, February, 1903, pp. 64–68.

(*b*) A series of bulletins of information printed in Manila by the Bureau of Public Printing, on behalf of the Manila Central Observatory. This series is a continuation of an earlier series, alternately 8vo and 4to, dealing with seismology and the seismic service of the archipelago. The first five are in Spanish; the sixth is by the Assistant Director of the Philippine Weather Bureau, M. Saderra Masó, S. J., entitled: Report on the Seismic and Volcanic Centers of the Philippine Archipelago. Manila, 1902. The preface is dated September, 1901. This pamphlet of 26 pages, with several maps, gives an admirable summary of our knowledge of Philippine vulcanology. On page 20 is given a table showing the monthly frequency of earthquakes during eighteen years. Nine hundred and sixty-two shocks are recorded, being an average of fifty-three earthquake days for last year, or 4.5 per month. An earthquake day is the date of the main shock, and does not include the subsequent shocks. The maximum frequency occurred in 1881 and again in 1897 and the minimum in 1886. The annual variation is such that we apparently have a minimum in March, a maximum in February, and a principal maximum in September; but these annual and monthly maxima are not sufficiently well marked to justify the conclusion that they represent normal periodicities. They will probably be changed by increasing the number of observers and the number of years of record, and, especially, by the substitution of seismographs for personal observations. In this same series of bulletins of information we must include the publications bearing on terrestrial magnetism, which began with the magnetic observations at Paragua, Jolo, and Mindanao in the year 1888; this subject includes five pamphlets, the last one being, The Magnetic Dip and Declination in the Philippine Islands. In this series, also, we include the publications bearing on meteorology proper. These begin with the pamphlet by Father Faura, On the Cyclones of October 20 and November 5, 1882, and include twenty-five pamphlets, of which the latest is by Father Algué, Observations of Soil Temperatures at Manila, 1896–1902. One of the most elaborate papers in this series is the Climatologia de Filipinas, which is a large collection of data and maps, 265 pages and 64 plates, printed at Washington in 1900.

(*c*) The third class of publications includes the regular monthly and annual volumes of data published in quarto. This series begins with the monthly bulletin in Spanish from 1865 to 1901, which contains the tables of meteorological, magnetic, and seismic observations; since 1901 agricultural data have been added. The monthly bulletin has gone through several slight changes as to its name and contents, but is sufficiently described by its title. The annual volumes begin with the Report of the Director of the Philippine Weather Bureau for 1901–2. This includes: Part 1. The Climate of Baguio (Beguet). Manila, 1902. Part 2. Report of the Director of the Philippine Weather Bureau, 1902. Meteorological Service of the Philippine Islands. Manila, 1903. Part 3. Hourly Observations of Atmospheric Phenomena at the Manila Central Observatory, 1902. Manila, 1903.

It is probable that these three parts, although they receive independent paginations, are intended to form one volume and there is nothing to indicate but that a fourth part will be necessary in order to complete the volume for the official year 1901–2. This first volume, therefore, as far as received, consists of 74 pages devoted to the climate of Baguio; 68 pages devoted to the history of the meteorological service of the Philippine Islands from its establishment in 1865, under the Spanish Government, to its organization in May, 1901, under the Government of the United States, concluding with the legislation of 1902; and 147 pages devoted to the complete record of hourly observations taken during the year 1902 at the Central Observatory of Manila.

Such a complete publication as this of records for Manila and

Baguio is a very important contribution to the material at hand for climatological studies. Baguio is about 2° north and a little west of Manila. It was established as a health resort early in 1900.

Although, properly speaking, a valley on the summit of a large mountain surrounded by deep canyons, we consider the ground where Baguio is situated as a plateau, since the valley is formed by slight undulations, caused by moderately sloping hills, which almost surround it, and on account of its presenting all the characteristics assigned in climatology to elevated plateaus. The plateau occupies an area of 150 hectares. The approximate geographical coordinates are: Latitude 16° 32′ north; longitude 12° 35′ east of Greenwich. The meteorological station was founded by the United States Philippine Commission in the early part of the month of August, 1900. In May, 1901, the station was incorporated into the Philippine Weather Bureau as a first-class station and was equipped with better instruments. As an inferior station of the first class, we have taken the one established in Dagupan, distant from Baguio 32 miles south-southeast. A barometric determination of the altitude of Baguio above sea level gives 4777 feet as the result. The diurnal barometric movement is much less in Baguio than in Manila, by reason of its elevation. The hours of maximum and minimum seem to be very nearly the same. The annual variation at Baguio seems to be more complex than at Manila, as the annual curve shows four maxima and minima at the former, as compared with two at the latter. The monthly mean temperature at Baguio has its minimum, 62.1° F., in February, and its maximum, 70.5° F., in April. The relative humidity is a minimum, 74 per cent, in April, and a maximum, 93 per cent, in August. The number of foggy days is a minimum, 3, in April, but a maximum, 25, in August. The rainfall was a minimum, 0.06 inch, in January, but a maximum, 37.03 inch, in August, 1901.

The historical sketch of the meteorological service of the Philippine Islands, published as Part 2 of the Report for 1902, was written by Father Marcial Solá, Secretary of the Philippine Weather Bureau. We make the following synopsis from this exceedingly interesting historical summary relative to the oldest meteorological service in the Orient:

For a long time previous to the year 1865 the professors in the college at Manila (known as the Ateneo or Athenæum) had dedicated themselves to the study of predicting the existence and course of cyclonic storms; they were further stimulated in this work by the destructive typhoon which devastated the Island of Luzon in September of that year. The first Director of the Manila Observatory was the Rev. Federico Faura. After fourteen years of study he began to publish predictions of the approach and severity of typhoons or baguios, the first one being made on July 1, 1879. The brilliant success of this and other predictions gave an immense impetus to the study. During the four years, 1879–1882, 53 typhoons were predicted and not a single mistake was made as to the position of the storm. In two cases the storm spent its force before arriving at the threatened points. Meteorological observations were taken by telegraph operators by order of the inspector general, after December 7, 1878. In 1880, after a cable had been laid between Manila and Hongkong, the governor of the latter place, Mr. J. Hennessey, sent an official communication to the governor of the Philippines asking that a regular daily cablegram be forwarded to Hongkong, since it was evident that the gyratory storms that reached the coast of China were felt several days beforehand in the Philippines.

The study of the general climatology of the Philippines began to be agitated in 1877 by Father Faura, by securing the establishment of secondary stations throughout the archipelago. Finally, in 1881, the project of building up, not only a general service, but an important central observatory was indorsed and, by royal decree of April 28, 1884, from Spain, fully provided for. The complete text of this decree established a service, having Manila as its center, with 6 stations to the south, 3 on the west, and 4 on the northern coast of Luzon, all in telegraphic communication; it provided that other stations should be established as fast as the telegraphic system was extended; it also provided for the cooperation of the naval stations under the merchant marine at points not reached by telegraph. Before the middle of 1887 13 such stations had been fully equipped. The public was educated as to the general method of predicting typhoons by a pamphlet prepared by Father Faura and, especially, by the introduction of his barocyclonoscope, which consists of an aneroid barometer having extra indices so arranged that if one index points toward the wind the other will point toward the center of the storm, and a third shows the mariner which way to steer. Eventually, also, 21 third-class stations were established and all of these kept records of earthquakes as well as of meteorological phenomena.

While this progress was going on in the Philippines other services were being established at Hongkong, Zi-Ka-Wei, and Tokio, so that the whole of the western portion of the North Pacific began to come under the daily inspection of competent meteorologists.

In 1896 and 1897 the observatory took a distinguished part in the international year of cloud work, the results of which were published in 1899. In 1897 Father Algué published in Manila his theoretical and practical study of the Philippine baguios or typhoons; portions of this have been published in French and German; although Father Sola thinks that sometimes sufficient credit has not been given to Father Algué, yet, we hardly agree with him, seeing that all meteorological work has to be reprinted and worked over from different points of view, and, in general, it is sufficient to say that one's studies are based upon the great collection of data furnished by Fathers Faura and Algué. A very interesting episode occurred in 1899 when, at the request of the Director of the Meteorological Service at Hongkong, the American military authorities cut off the transmission of typhoon warnings to that place. This raised a storm of indignation in the latter station, the outcome of which was a complete vindication of the importance of the work that had been done in Manila and the speedy resumption of the storm warnings, which have continued to be sent since April 3 of that year, much to the gratification of all mariners. The memoir by Father Sola gives, among other things, a fine illustration of the Algué nephoscope, or the "refraction nephoscope," invented by him in 1900 and, apparently, now for the first time described. The installation of the observatory and its apparatus is quite ideal as regards meteorological conditions. The meteorological park consists of two small portions with a large garden belonging to the observatory. The ground is covered with grass and not flooded with rain during the wet season. Thermometers are exposed according to the several methods used by the Weather Bureau, by the Russian service, and by the Indian service. The Richard self-registering actinometer is kept in operation, as well as the one invented by Arago. But as these can not replace the exact work done with Violle's apparatus, it is to be hoped that the latter also may be added to this. A daily weather map is maintained for the archipelago and surrounding oceans, based upon 25 cable stations, in addition to the telegraphic reports from the Philippines. Since this report was published the American cables to Guam, Midway Island, and Manila have been finished, and we doubt not that these important outlying stations will be added. For these cable reports, and, we believe, for general use throughout the Philippines, an international time standard has been adopted, namely, that of the one hundred and twentieth meridian, or eight hours east of Greenwich. The exact longitude of the meridian of the observatory at Manila is 8h. 3m. 54.2s.

On May 22, 1901, the United States Commission to the Philippines enacted a law, which is published in full in the MONTHLY WEATHER REVIEW for 1901, p. 372, confirming the organization of the "Philippine Weather Bureau" and all the details of its work, its official staff, and its relation to the Government. Comparing all that is comprehended in this law with the services, above described, which the observatory had for many years been performing, it will be seen that scarcely anything has been altered as regards the amount and character of the work done. The Meteorological Weather Bureau of the Phil-

ippines comes directly under the local Secretary of the Interior, through whom it reports to the Governor of the Philippines and the Bureau of Insular Affairs at Washington. Since the reorganization, 1901, the number of reporting stations has been as follows: 1 central observatory; 9 first-class stations; 25 second-class; 17 third-class; 21 special rainfall stations. Three meteorological expeditions have been made for the installation of new stations and the inspection of old ones. The study of earthquakes and magnetics continues to be provided for in connection with meteorology. The first and second class stations make monthly reports. The cooperation of the Chief of the United States Weather Bureau is most heartily acknowledged. The report closes with a complete bibliography of the publications of the Philippine Weather Service and its predecessor, the Manilla Observatory.

LONG-RANGE FORECASTING.

In the official forecasts dated at 8 p. m. on Monday, November 2, Prof. E. B. Garriott says:

Observation has shown that periods of low barometric pressure over the British Isles are attended by stagnated weather conditions over the western Atlantic and the eastern part of the American Continent, and that five or six days after reestablishment of normal barometric pressures over the eastern Atlantic the usual progression of areas of high and low barometer over the United States is resumed. An instance of this kind has been presented during the past week. On Friday last an area of low barometer that had occupied the British Isles for several days began an eastward movement, and to-day the high barometer area that has persistently occupied the east-central part of the United States since last Tuesday shows signs of dissolution. The effect of these barometric changes will probably be shown in a gradual breaking up of the quiescent weather conditions that have prevailed since the 27th ultimo over the eastern part of the United States. There are at present, however, no indications of the development of a well-marked storm in the United States.

This interesting generalization and forecast is commented upon by Mr. James P. Hall editorially in the New York Tribune of November 5, as follows:

The most noteworthy thing about this statement is that it betrays a disposition to extend the range of Government forecasts beyond a period of twenty-four or thirty-six hours. It shows that some of the true principles of long-range work have been discovered and excites hope that in time it may be practicable to issue frequent intimations of the same character that will be thoroughly trustworthy. Should further experience verify the soundness of the particular statement here referred to, it will freshly illustrate the necessity of looking to the east, as well as to the west, in formulating opinions about coming weather.

In fact, experts will probably not get at the bottom of the whole matter until they discover the relations existing between conditions prevailing in America and continents as far distant as Asia and Australia. Whether the influences which disturb the atmosphere be simply thermal or include magnetic and other solar radiations, the effects should be widespread, if not universal. If the meteorologist can once discover only a part of any regular sequence of events, it may help him to find other members of the system.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

Two well-defined areas of high mean barometric pressure are shown by the isobars for the month. The principal one overlay the northern Plateau and northern part of the middle Plateau regions, with the crest, showing mean of 30.15 to 30.17 inches, over west-central Wyoming, southern Idaho, and eastern Oregon. The secondary area of high pressure overlay the northern portion of the east Gulf States, the Ohio Valley and Tennessee, northwestern Ohio, Indiana, Illinois generally, south-central Iowa, Missouri, Arkansas, and northern Louisiana, with the crest, bearing a mean of 30.15 inches of pressure, over central Tennessee.

The mean pressure was low over the southern Plateau regions and the valleys of California, with a minimum mean of 29.91 inches at Yuma.

The mean pressure diminished from that of the preceding month in the Atlantic States north of Georgia, and in the upper Ohio Valley, lower Lake region, and eastern portion of the upper Lake region; elsewhere there was an increase over September. The greatest decreases occurred on the middle Atlantic and southern New England coasts, and the greatest increases over the middle Plateau and southern portion of the northern Plateau regions. The maximum increases were .05 inch higher than the maximum decreases, and the area of increase was much greater than that of decrease.

The mean barometer was slightly below the normal in New England, the Middle Atlantic States, northern part of the South Atlantic States, eastern part of the lower Lake region, and in north-central California; elsewhere it was above the normal, and generally with departures greater than in the area over which the mean pressure was below the normal.

TEMPERATURE OF THE AIR.

The mean temperature was below the normal in the South Atlantic States, Florida Peninsula, west Gulf, and southern slope regions; normal in the east Gulf States and above normal in the remaining geographic districts.

Departures ranging from —1.1° to —1.3° per day were reported from the western portion of the Florida Peninsula, and from —1.3° to —1.8° per day over east-central and northeastern Texas; over the remainder of the area of minus departure the changes were slight.

As a rule the plus departures were marked, being an average of +1.0°, or more, per day generally over the northern two-thirds of the country; +2.0°, or more, per day over the northern half of the country, except the State of Washington; +4.0°, or more, per day in north-central upper Michigan, western Minnesota, the Dakotas, except southwestern South Dakota, central Nebraska, Montana, southwestern Idaho, and northeastern California, and +5.0°, or more, per day in central Montana.

The isotherm of 70° of mean temperature trends westward as far as longitude 100°, just to the southward of latitude 30°; it also incloses an area of slight extent over the southern Plateau region. The isotherm of 60° lay generally slightly to the northward of the thirty-fifth parallel as far west as longitude 105°, then southwestward to longitude 110°, and thence northwestward to northwestern California, and the isotherm of 50° generally slightly to the southward of latitude 45° westward to longitude 105°, then trends southward to central Arizona and thence northward over central Washington. An area of less than 50° of mean temperature overlay portions of the middle Plateau region.

Maximum temperatures of 90°, or higher, occurred in the central portion of the Florida Peninsula, in the east Gulf States except along the coast, the western parts of Tennessee and Kentucky, the interior of Louisiana generally, the interior of southeastern and the eastern portion of the panhandle of Texas, southeastern New Mexico, central Nebraska, the western portions of Kansas and Oklahoma, extreme southeastern Colorado, south-central and western Arizona, and California, except along the coast north of San Francisco and the extreme southwestern part.

Maximum temperatures of 80°, or higher, occurred, except in New England, the northern portion of the Middle Atlantic States, upper Lake region, except about southern Lake Michigan, Wisconsin generally, Minnesota, eastern South

Dakota, North Dakota, and portions of the slope and Plateau regions.

Freezing temperatures were reported from all States, except Florida, the isotherm of minimum temperature of 32°, extending to eastern and southern New Jersey, central Maryland, the extreme eastern portions of Virginia and the Carolinas, the central portions of Georgia and Alabama, extreme southern and southwestern Mississippi, western Arkansas, south-central Missouri, northeastern Oklahoma, south-central Kansas, western Texas, southwestern Arizona, extreme eastern California, and the western portions of Oregon and Washington.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart VI.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	51.5	+ 1.3	+ 6.2	+ 0.6
Middle Atlantic	12	57.1	+ 1.2	+ 8.7	+ 0.9
South Atlantic	10	62.8	− 0.2	+ 3.7	+ 0.4
Florida Peninsula*	8	72.3	− 0.7	+ 5.1	+ 0.5
East Gulf	9	65.8	0.0	− 7.7	− 0.8
West Gulf	7	66.3	− 0.8	−11.8	− 1.2
Ohio Valley and Tennessee	11	57.9	+ 0.9	+ 4.9	+ 0.5
Lower Lake	8	53.4	+ 2.0	+10.9	+ 1.1
Upper Lake	10	49.6	+ 2.5	+13.1	+ 1.3
North Dakota*	8	47.6	+ 4.2	+ 1.3	+ 0.1
Upper Mississippi Valley	11	54.6	+ 1.9	+ 5.9	+ 0.6
Missouri Valley	11	55.3	+ 2.7	+ 2.0	+ 0.2
Northern Slope	7	50.1	+ 4.1	+ 0.2	0.0
Middle Slope	6	56.8	+ 1.4	− 5.2	− 0.5
Southern Slope*	6	61.7	− 0.1	−10.5	− 1.0
Southern Plateau*	13	58.6	+ 0.5	−12.7	− 1.3
Middle Plateau*	8	50.9	+ 2.4	−21.6	− 2.2
Northern Plateau*	12	50.1	+ 2.1	+ 2.2	+ 0.2
North Pacific	7	53.1	+ 1.8	− 1.8	− 0.2
Middle Pacific	5	61.6	+ 3.4	− 4.7	− 0.5
South Pacific	4	65.3	+ 1.8	− 3.3	− 0.3

*Regular Weather Bureau and selected voluntary stations.

In Canada.—Prof. R. F. Stupart says:

The temperature was above the average over the Dominion, except in British Columbia and in the extreme eastern portions of the Maritime Provinces. The positive departures were, as a rule, pronounced, especially in Manitoba and the Northwest Territories, where they ranged from 4° to 7°; also in the Peninsula of Ontario, where in many localities they were from 3° to 4°. The negative departures did not exceed 2° in British Columbia, and only 1° in the Maritime Provinces.

PRECIPITATION.

The distribution of total monthly precipitation is shown on Chart III.

The precipitation was normal in North Dakota and the upper Mississippi Valley; slightly above in the Missouri Valley and middle slope region; decidedly above in the Middle Atlantic States, and below normal in the remaining geographic districts, the deficiency being marked in the north and middle Pacific and southern slope regions, and in the Florida Peninsula.

Over Florida generally the deficiency in rainfall amounted to over 2 inches, and over the east-central coast it amounted to nearly 8.0 inches. Deficiencies of 2.0 inches, or more, also occurred over southwestern Tennessee and the extreme northwestern portion of Washington. Excesses of + 1.5 inches to + 3.6 inches are reported from southwestern Missouri, eastern Kansas, New Jersey, Delaware, and the eastern parts of Virginia, Maryland, Pennsylvania, and New York. In eastern New Jersey and southeastern New York the excess ranged from + 8.0 to + 8.8 inches.

Precipitation amounting to more than 6.00 inches occurred along the coasts of northwestern Oregon and southwestern Washington; also in the eastern portions of New York, and Pennsylvania, in New Jersey, Delaware, the southern part of the eastern shore of Maryland, and extreme southeastern Virginia.

Snow fell in measurable amounts in the Rocky Mountain regions north of New Mexico, and in portions of the following districts: the Dakotas, Minnesota, Lake region, New England, and the northern portion of the Middle Atlantic States.

HAIL.

The following are the dates on which hail fell in the respective States:

Arizona, 1, 2. Arkansas, 31. California, 10. Colorado, 11, 30. Idaho, 4, 6, 28. Illinois, 3, 6, 7, 15, 23. Indiana, 17, 18, 23. Indian Territory, 30. Iowa, 2, 3, 4, 5, 6, 7, 12. Kansas, 1, 2, 6, 7, 12, 13, 14, 15, 30, 31. Louisiana, 13, 15. Maine, 26. Maryland, 2, 26. Michigan, 8, 10, 17, 26. Minnesota, 3, 4, 11, 30. Missouri, 4, 6, 7. Montana, 1, 3, 6. Nebraska, 2, 3, 5, 6. Nevada, 1. New Hampshire, 5, 27, 29. New York, 17, 18, 22, 27. North Carolina, 24, 25. North Dakota, 2. Ohio, 4, 7, 22, 23. Oklahoma, 4, 30, 31. Pennsylvania, 17, 23, 26. South Dakota, 3, 11. Texas, 4, 15, 31. Utah, 1, 2, 3, 29. Washington, 28. Wisconsin, 3, 17, 30. Wyoming, 2, 5, 6, 29.

SLEET.

The following are the dates on which sleet fell in the respective States:

Colorado, 3, 30, 31. Kansas, 31. Maine, 26. Massachusetts, 23, 26. Michigan, 16, 17, 18, 23, 25. Minnesota, 3, 4, 16, 22. Montana, 1, 3, 6, 11. Nevada, 1. New York, 18, 24, 26, 27, 28. North Carolina, 23, 25. North Dakota, 1. Ohio, 23. Utah, 2, 29. Virginia, 24, 25. Wisconsin, 17. Wyoming, 6.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	3.08	79	−0.8	−2.0
Middle Atlantic	12	5.74	177	+2.5	+2.5
South Atlantic	10	2.86	76	−0.9	−1.7
Florida Peninsula*	8	1.82	38	−3.0	+3.0
East Gulf	9	1.88	70	−0.8	−3.7
West Gulf	7	2.70	96	−0.1	0.0
Ohio Valley and Tennessee	11	2.17	84	−0.4	−5.4
Lower Lake	8	2.90	94	−0.2	+2.0
Upper Lake	10	2.35	80	−0.6	+0.8
North Dakota*	8	1.02	100	0.0	−1.4
Upper Mississippi Valley	11	2.39	100	0.0	+1.6
Missouri Valley	11	2.16	110	+0.2	+4.1
Northern Slope	7	0.35	41	−0.5	+0.6
Middle Slope	6	2.47	157	+0.9	+1.0
Southern Slope*	6	1.01	50	−1.0	−2.2
Southern Plateau*	13	0.37	48	−0.4	+0.5
Middle Plateau*	8	0.52	57	−0.4	−0.6
Northern Plateau*	12	0.83	67	−0.4	−3.4
North Pacific	7	2.92	65	−1.6	−8.2
Middle Pacific	5	0.70	41	−1.0	−5.4
South Pacific	4	0.02	3	−0.6	−0.2

*Regular Weather Bureau and selected voluntary stations.

In Canada.—Professor Stupart says:

The rainfall was below the average in nearly all portions of Canada, except locally, these exceptions being Ontario, south and east of the Georgian Bay district to the boundary, Montreal and its vicinity, Nova Scotia, and a few isolated places in Manitoba, Saskatchewan and Alberta. The most general marked deficiency, amounting to an inch and over, occurred in the Province of Quebec; elsewhere the minus departures varied from one to nine-tenths of an inch.

SUNSHINE AND CLOUDINESS.

The cloudiness was normal in the South Atlantic States; above normal in New England and the Middle Atlantic and west Gulf States, and the middle and southern slopes and middle Pacific regions, and below normal in the remaining geographic districts.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographic districts, appear in Table I.

The averages for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.8	+ 0.3	Missouri Valley	3.8	− 0.1
Middle Atlantic	5.6	+ 0.8	Northern Slope	3.3	− 0.9
South Atlantic	4.0	0.0	Middle Slope	3.6	+ 0.5
Florida Peninsula	4.5	− 0.2	Southern Slope	3.8	+ 1.0
East Gulf	3.5	− 0.1	Southern Plateau	0.8	− 1.2
West Gulf	3.9	+ 0.3	Middle Plateau	2.6	− 0.6
Ohio Valley and Tennessee	4.0	− 0.5	Northern Plateau	3.9	− 0.9
Lower Lake	5.6	− 0.2	North Pacific	5.8	− 0.1
Upper Lake	4.7	− 1.4	Middle Pacific	4.1	+ 0.4
North Dakota	3.8	− 1.3	South Pacific	2.0	− 1.0
Upper Mississippi Valley	3.7	− 0.7			

HUMIDITY.

The humidity was normal in New England, the South Atlantic States, Ohio Valley and Tennessee, and north Pacific coast region; above in the lower Lake region, upper Mississippi Valley, and the slope regions; and below normal in the remaining geographic districts.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	79	0	Missouri Valley	64	− 3
Middle Atlantic	75	− 1	Northern Slope	62	+ 2
South Atlantic	78	0	Middle Slope	60	+ 1
Florida Peninsula	75	− 5	Southern Slope	64	+ 1
East Gulf	71	− 2	Southern Plateau	37	− 5
West Gulf	71	− 1	Middle Plateau	46	− 3
Ohio Valley and Tennessee	71	0	Northern Plateau	61	− 2
Lower Lake	75	+ 1	North Pacific	83	0
Upper Lake	76	− 2	Middle Pacific	70	− 2
North Dakota	68	− 4	South Pacific	68	− 2
Upper Mississippi Valley	74	+ 3			

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 1770 thunderstorms were received during the current month as against 1800 in 1902 and 3155 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 3d, 176; 7th, 175; 4th, 167; 6th, 163.

Reports were most numerous from: Missouri, 178; Ohio, 138; Iowa, 119; Kansas, 111.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: 2d to 10th.

In Canada: Thunderstorms were reported at St. John, N. B., 17. Grand Manan, 17. Yarmouth, 17. Toronto, 1, 17. White River, 4. Port Stanley, 1, 7, 8, 15, 16. Saugeen, 17. Parry Sound, 1, 4, 7, 15. Port Arthur, 3, 4. Winnipeg, 3, 6. Minnedosa, 6. Edmonton, 21. Sable Island, 12. Hamilton, Bermuda, 12, 20.

Auroras were reported from St. John, N. B., 31. St. Johns, N. F., 31. Halifax, 31. Grand Manan, 31. Charlottetown, 31. Father Point, 12, 13. Quebec, 13. Montreal, 13, 31. Bissett, 12, 13. Ottawa, 12, 13. Kingston, 12, 13. White River, 12, 13, 31. Port Stanley, 12. Saugeen, 12, 31. Parry Sound, 12. Port Arthur, 31. Winnipeg, 11, 12, 30, 31. Minnedosa, 13, 14, 15, 25, 26, 31. Qu'Appelle, 13, 31. Swift Current, 12, 26, 30, 31. Banff, 31. Edmonton, 13, 14, 26, 29, 31. Prince Albert, 11, 25, 26, 30, 31. Battleford, 25, 26, 27, 30, 31. Victoria, 31. New Westminster, 31. Sable Island, 31.

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Bismarck, N. D	7	53	nw.	Mount Tamalpais, Cal	1	52	nw.
Block Island, R. I	9	51	e.	Do	6	62	nw.
Do	10	60	ne.	Do	8	61	sw.
Do	11	62	ne.	Do	9	54	s.
Do	12	55	n.	Do	28	50	nw.
Do	26	52	nw.	New York, N. Y	18	50	nw.
Cape Henry, Va	8	58	n.	Do	26	53	nw.
Do	9	72	n.	North Head, Wash	5	73	s.
Do	10	74	e.	Do	10	54	se.
Do	11	56	ne.	Do	31	54	se.
Do	18	54	nw.	Point Reyes Light, Cal	5	50	nw.
Do	24	52	n.	Do	6	51	nw.
Do	25	52	n.	Do	9	60	s.
Chicago, Ill	7	50	s.	Do	28	60	nw.
Eastport, Me	18	50	se.	Sioux City, Iowa	7	58	w.
Hatteras, N. C	9	63	ne.	Tatoosh Island, Wash	5	78	sw.
Do	10	53	n.	Do	22	56	e.
Do	18	50	n.	Do	31	52	s.
Do	24	56	ne.	Valentine, Nebr	7	57	nw.
Do	25	51	n.	Williston, N. Dak	21	51	nw.
Huron, S. Dak	7	50	nw.	Winnemucca, Nev	9	56	w.
Do	10	55	s.				

DESCRIPTION OF TABLES AND CHARTS.

By Mr. W. B. STOCKMAN, Forecast Official, in charge of Division of Meteorological Records.

For description of tables and charts see page 286 of REVIEW for June, 1903.

TABLE 1.—*Climatological data for Weather Bureau stations, October, 1903.*

Stations.	Elevation of instruments. Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Temperature of the air, in degrees Fahrenheit. Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches. Total.	Departure from normal.	Days with .01, or more.	Wind. Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
New England.							51.5	+ 1.3										79	3.08	— 0.8										5.3	
Eastport	76	69	82	29.92	30.00	.00	47.4	+ 0.6	71	1	52	27	29	42	23	44	41	81	2.83	— 1.2	12	9,784	nw.	50	se.	18	7	9	15	6.4	1.2
Portland, Me.	103	81	117	29.89	30.01	— .03	49.6	+ 0.5	72	1	57	26	28	42	30	46	42	78	3.57	— 0.3	11	7,496	sw.	32	e.	8	9	10	12	5.7	
Concord	298	70	79	29.70	30.02	— .03	49.1	— 0.4	72	2	59	23	25	39	38				3.27	— 0.3	12	4,530	nw.	28	nw.	26	10	8	13	5.9	T.
Northfield	876	16	60	29.08	30.04	.00	45.4	+ 2.1	69	5	56	18	29	35	38	42	39	81	2.75	+ 0.5	12	6,244	s.	32	w.	31	6	9	16	7.2	1.4
Boston	125	115	181	29.88	30.03	— .02	53.9	+ 2.0	76	1	61	31	25	47	30	49	44	73	3.95	— 0.4	11	8,757	sw.	35	ne.	10	11	10	10	5.0	
Nantucket	12	43	85	29.99	30.00	— .05	54.4	+ 1.8	70	5	59	34	28	50	22	51	48	81	3.33	— 0.6	11	13,524	n.	48	ne.	11	8	11	12	6.0	T.
Block Island	26	11	60	30.00	30.03	— .02	55.7	+ 2.1	72	2	60	35	27	51	20	52	48	77	2.66	— 1.8	12	16,335	sw.	62	ne.	11	12	10	9	4.9	
Narragansett	......	10	38	......	......	......	53.2	+ 0.9	73	*	61	24	29	46	34	......	......	......	2.41	— 2.4	10	......	nw.	......	......	......	16	4	11	......	T.
New Haven	106	117	140	29.91	30.03	— .03	54.4	+ 2.0	77	2	62	30	25	46	29	50	47	79	2.94	— 1.1	14	8,397	n.	43	ne.	10	14	7	10	4.9	T.
Mid. Atlantic States.							57.1	+ 1.2										75	5.74	+ 2.5										5.6	
Albany	97	102	115	29.93	30.04	— .02	52.8	+ 2.2	73	8	61	29	25	44	31	48	45	80	6.09	+ 2.9	13	6,117	s.	34	s.	22	11	8	12	5.6	0.3
Binghamton	875	79	90	29.10	30.04	— .02	50.8	+ 2.7	73	1	59	25	25	42	35				5.74	+ 2.8	14	4,562	nw.	27	se.	8	5	7	19	6.9	0.2
New York	314	108	350	29.69	30.03	— .03	56.6	+ 1.6	75	2	63	34	25	50	23	52	47	75	11.55	+ 8.0	13	10,614	nw.	53	nw.	26	8	9	14	5.9	T.
Harrisburg	374	94	104	29.66	30.07	— .01	56.0	+ 3.5	77	7	64	37	27	48	28	50	44	70	2.62	— 0.4	9	5,800	nw.	32	n.	9	9	10	12	5.8	T.
Philadelphia	117	168	184	29.92	30.05	— .02	57.8	+ 2.0	80	7	66	35	27	50	24	52	47	72	3.66	+ 1.0	9	9,229	n.	37	ne.	10	9	11	11	5.6	T.
Scranton	805	111	119	29.19	30.07	.00	52.6	......	77	1	61	29	25	44	32	48	44	78	6.42	......	9	5,956	sw.	33	nw.	26	7	4	20	7.2	T.
Atlantic City	52	39	48	29.98	30.03	— .04	58.2	+ 1.9	76	2	65	34	27	52	26	54	50	78	12.13	+ 8.8	10	7,701	sw.	42	ne.	10	8	15	8	5.7	
Cape May	17	47	51	30.04	30.06	— .01	58.4	— 0.5	78	2	64	37	25	53	18	54	......	......	5.67	+ 2.1	9	7,442	nw.	35	ne.	10	9	13	9	5.6	T.
Baltimore	123	60	117	29.92	30.05	— .03	58.4	+ 1.5	83	2	67	35	27	50	30	51	46	67	3.54	+ 0.6	8	6,329	nw.	42	n.	9	9	7	15	6.1	T.
Washington	112	59	76	29.94	30.07	— .01	56.8	+ 0.6	80	5	66	33	27	47	39	51	48	79	4.48	+ 1.4	10	5,327	nw.	40	nw.	9	16	6	9	4.6	
Cape Henry	18	11	58	30.01	30.03	— .04	60.3	— 1.5	82	6	67	36	28	54	26	......	......	......	5.04	+ 1.3	9	13,395	n.	74	ne.	10	13	8	10	4.6	
Lynchburg	681	83	88	29.33	30.08	— .01	58.0	+ 0.9	81	5	68	29	28	48	37	51	47	76	2.09	— 1.2	4	3,299	nw.	28	nw.	9	12	9	10	5.1	
Norfolk	91	102	111	29.96	30.07	.00	60.6	0.0	83	6	69	36	28	52	28	55	52	79	6.08	+ 2.2	9	7,222	n.	45	n.	10	12	6	13	5.5	
Richmond	144	82	90	29.92	30.08	.00	58.9	......	83	6	69	35	27	49	33	......	......	......	3.44	......	11	4,414	nw.	30	n.	9	11	8	12	5.5	
Wytheville	2,293	40	47	27.73	30.13	+ .04	53.2	......	79	1	65	24	28	41	41	45	41	72	1.60	......	5	4,121	nw.	24	nw.	18	14	11	6	3.7	
S. Atlantic States.							62.8	— 0.2										78	2.86	— 0.9										4.0	
Asheville	2,255	53	75	27.78	30.11	+ .02	54.2	+ 0.6	81	5	66	25	28	42	39	47	44	76	1.77	— 0.8	5	5,720	nw.	34	nw.	9	15	12	4	4.2	
Charlotte	773	68	76	29.26	30.11	+ .03	60.8	+ 0.5	84	2	71	34	27	51	28	53	48	70	2.53	— 1.1	6	4,155	s.	26	ne.	10	15	10	6	4.0	
Hatteras	11	12	47	30.03	30.04	— .02	64.0	— 0.5	81	5	70	43	28	58	18	61	59	88	4.47	— 1.7	9	10,466	n.	63	n.	9	16	8	7	3.9	
Raleigh	376	93	101	29.68	30.08	+ .01	59.8	+ 1.8	85	5	70	34	28	49	31	53	49	76	5.28	+ 1.9	7	4,203	nw.	26	nw.	9	15	10	6	3.8	T.
Wilmington	78	82	90	29.96	30.05	— .01	62.3	— 1.2	84	2	72	37	28	53	31	56	54	82	2.46	— 1.4	6	5,521	nw.	35	nw.	9	17	6	8	4.0	
Charleston	48	14	92	30.03	30.08	+ .02	65.6	— 1.1	83	3	73	40	25	58	25	59	55	76	2.30	— 1.9	6	7,429	e.	42	ne.	24	12	13	6	4.5	
Columbia, S. C.	351	167	175	29.71	30.09	+ .02	63.6	0.0	86	2	73	34	25	54	28	57	54	79	1.94	— 0.4	4	6,569	nw.	46	n.	10	15	9	7	4.2	
Augusta	180	89	97	29.89	30.09	+ .02	62.8	— 0.9	87	2	74	32	28	51	35	55	52	78	1.82	— 0.7	4	3,592	nw.	30	ne.	24	21	4	6	3.4	
Savannah	65	79	89	30.01	30.07	+ .02	66.2	— 0.2	86	3	75	38	25	58	29	59	56	78	3.24	— 0.4	8	5,088	n.	30	n.	10	15	10	6	3.9	
Jacksonville	43	101	129	29.99	30.04	+ .02	68.8	— 0.9	86	7	77	41	25	61	29	62	59	79	2.83	— 2.4	7	6,586	ne.	42	sw.	17	14	11	6	4.3	
Florida Peninsula.							74.8	— 0.9										75	2.28	— 3.9										4.5	
Jupiter	28	10	48	29.96	29.99	+ .03	75.4	0.0	88	8	81	52	25	69	21	68	65	72	1.81	— 7.8	10	9,449	ne.	34	ne.	28	13	15	3	4.3	
Key West	22	10	53	29.94	29.97	+ .03	77.2	— 1.3	86	17	82	61	25	73	14	71	68	78	4.10	— 1.2	13	7,942	ne.	25	w.	9	10	15	6	4.9	
Sand Key	24	......	......	29.93	29.96	......	77.1	......	87	8	80	63	25	74	12	......	......	......	1.58	......	7	14,100	ne.	40	e.	30	12	13	6	4.6	
Tampa	34	60	67	29.97	30.01	+ .03	71.7	— 1.4	89	6	80	45	26	63	26	64	61	76	0.93	— 2.8	5	4,682	ne.	24	s.	17	13	12	6	4.2	
East Gulf States.							65.8	0.0										71	1.88	— 0.8										3.5	
Atlanta	1,174	190	216	28.86	30.10	+ .03	62.2	0.0	84	2	71	31	25	53	29	53	46	64	0.94	— 1.4	5	8,653	nw.	38	nw.	9	16	11	4	3.4	
Macon	370	93	99	29.70	30.10	+ .04	63.6	......	88	3	75	35	25	53	34	......	......	......	2.25	......	3	3,847	n.	24	nw.	8	17	6	8	3.7	
Pensacola	56	79	96	30.01	30.07	+ .04	68.6	— 0.6	89	4	76	40	25	61	27	......	......	......	6.00	+ 2.7	6	7,065	ne.	30	n.	24	15	10	6	3.6	
Birmingham	700	136	143	29.36	30.13	+ .06	63.8	— 1.3	89	3	74	32	25	54	31	......	......	......	2.63	— 0.3	4	5,664	ne.	31	n.	7	20	8	3	3.0	
Mobile	57	88	96	30.01	30.07	+ .03	67.4	0.0	88	4	76	38	25	58	33	59	54	72	0.99	— 2.4	5	5,491	n.	34	n.	24	18	9	4	3.1	
Montgomery	223	100	112	29.85	30.07	+ .01	65.4	+ 0.2	90	3	76	36	25	55	32	57	53	72	1.65	— 0.7	3	4,414	e.	28	n.	24	16	10	5	3.6	
Meridian	375	84	93	29.70	30.10	+ .04	63.6	+ 1.4	90	3	76	30	25	51	44	......	......	......	1.02	— 0.6	5	3,508	ne.	28	n.	7	16	10	5	3.4	
Vicksburg	247	62	74	29.81	30.08	+ .02	65.2	— 0.1	89	2	76	39	25	55	28	57	53	76	0.96	— 1.7	5	4,092	n.	21	nw.	8	17	8	6	3.6	
New Orleans	51	88	121	30.02	30.08	+ .05	70.0	+ 0.2	89	7	78	49	25	62	23	62	57	72	0.81	— 2.4	6	6,128	ne.	28	n.	24	12	12	7	4.5	
West Gulf States.							66.3	— 0.8										71	2.70	— 0.1										3.9	
Shreveport	249	77	84	29.83	30.10	+ .05	64.8	— 0.5	88	3	76	40	24	54	33	56	51	70	2.33	— 0.8	5	3,994	nw.	21	ne.	4	19	5	7	3.8	
Fort Smith	457	79	94	29.61	30.08	+ .03	61.2	+ 0.1	86	2	72	35	24	50	40	53	49	74	2.71	— 0.1	10	5,511	e.	32	e.	30	11	12	8	4.5	
Little Rock	357	93	100	29.73	30.12	+ .06	62.4	+ 0.1	87	2	72	39	25	53	35	54	49	68	2.04	— 0.4	5	5,134	ne.	27	nw.	7	18	6	7	3.5	
Corpus Christi	20	48	53	30.03	30.05	+ .05	71.7	— 0.8	87	7	78	50	25	65	23	65	62	75	1.74	— 0.5	12	6,588	se.	31	n.	15	14	12	5	3.8	
Fort Worth	670	106	114	29.38	30.09	+ .06	63.7	......	87	4	74	38	24	53	34	......	......	......	4.53	......	7	6,837	s.	35	sw.	31	16	13	2	3.3	
Galveston	54	106	112	29.99	30.06	+ .03	70.5	— 1.8	85	4	75	54	24	66	15	64	60	73	3.60	— 0.6	8	8,226	ne.	44	nw.	15	20	7	4	2.9	
Palestine	510	73	79	29.56	30.10	+ .07	64.8	— 1.7	86	3	74	43	24	55	29	57	53	75	4.90	+ 1.7	8	5,039	ne.	28	ne.	15	13	11	7	4.3	
San Antonio	701	80	91	29.33	30.05	+ .04	68.4	— 1.3	94	7	80	40	25	57	37	58	52	64	1.61	— 0.1	5	4,953	se.	38	n.	15	14	14	3	4.0	
Taylor	583	55	63	29.47	30.08	+ .06	65.2	......	90	7	78	38	25	52	38	......	......	......	2.56	......	5	5,184	n.	30	sw.	31	11	10	10	5.0	
Ohio Val. and Tenn.							57.9	+ 0.9										71	2.17	— 0.4										4.0	
Chattanooga	762	106	112	29.33	30.15	+ .06	60.0	— 0.5	89	3	71	29	28	49	34	51	46	68	3.44	+ 0.7	7	4,943	n.	37	w.	7	16	11	4	3.3	
Knoxville	1,004	35	88	29.07	30.13	+ .04	57.8	+ 0.2	85	4	70	30	25	46	35	49	44	69	1.88	— 0.9	7	4,713	n.	32	s.	7	18	8	5	3.6	
Memphis	397	146	154	29.70	30.12	+ .05	62.6	+ 1.0	87	2	72	39	28	53	28	55	50	73	0.25	— 2.5	2	6,738	ne.	32	n.	23	19	6	6	2.8	
Nashville	546	122	134	29.55	30.15	+ .07	60.8	+ 1.2	92	3	72	32	25	50	37	51	45	67	2.06	— 0.4	6	4,760	nw.	30	sw.	7	20	5	6	3.1	
Lexington	989	75	102	29.07	30.14	+ .06	56.9	+ 1.1	86	3	66	28	24	47	31	......	......	......	2.12	— 0.1	7	7,201	s.	40	s.	7	14	11	6	4.0	
Louisville	525	114	136	29.56	30.14	+ .06	58.8	+ 1.1	90	3	70	30	25	48	34	50	45	69	1.60	— 1.2	5	5,462	n.	30	s.	7	15	13	3	3.6	
Evansville	431	72	82	29.64	30.11	+ .03	59.0	......	88	3	68	34	28	49	33	......	......	......	1.87	......	5	4,908	ne.	34	s.	7	19	7	5	3.3	
Indianapolis	822	154	164	29.23	30.13	+ .06	55.4	+ 1.0	85	3	64	29	27	47	29	49	44	73	3.67	+ 0.9	8	7,195	s.	48	w.	7	17	6	8	3.7	
Cincinnati	628	152	160	29.45	30.13	+ .05	57.5	+ 1.1	86	3	67	30	25	48	35	49	43	66	1.31	— 1.1	7	4,482	se.	41	sw.	7	13	13	5	4.1	
Columbus	824	173	190	29.24	30.11	+ .03	55.4	+ 1.7	83	3	65	27	24	46	30	48	43	71	1.84	— 0.8	7	8,265	sw.	48	sw.	7	14	8	9	4.8	
Pittsburg	842	116	123	29.19	30.10	+ .02	56.2	+ 1.5	88	4	65	32	25	47	29	49	43	68	2.88	+ 0.4	10	4,302	n.	30	s.	7	12	12	7	4.5	T.
Parkersburg	638	77	84	29.46	30.15	+ .07	56.0	+ 0.9	88	4	66	27	25	46	38	50	46	78	2.86	+ 0.7	8	4,108	s.	38	nw.	4	13	6	12	5.3	
Elkins	1,940	41	50	28.07	30.13	+ .03	51.2	......	84	4	63	20	25	39	42	44	41	81	1.79	......	12	2,624	n.	23	s.	7	9	13	9	5.6	T.
Lower Lake Region.							53.4	+ 2.0										75	2.90	— 0.2										5.6	
Buffalo	767	178	206	29.22	30.05	.00	53.2	+ 2.9	79	7	59	31	27	48	26	49	45	75	2.15	— 1.5	12	11,799	w.	45	w.	8	3	11	17	7.0	0.2
Oswego	335	76	91	29.65	30.03	— .02	51.6	+ 1.6	73	7	58	30	27	45	29	47	43	77	4.88	+ 1.6	13	8,807	s.	38	n.	26	4	15	12	6.4	5.0
Rochester	523	81	102	29.47	30.05	.00	52.5	+ 2.9	78	4	60	29	27	45	31	47	43	76	2.93	0.0	15	6,827	sw.	30	w.	29	4	15	12	6.6	0.6
Syracuse	597	97	113	29.39	30.03	— .03	51.6	......	71	7	58	29	28	45	27	......	......	......	6.36	......	16	9,256	s.	48	s.	22	1	17	13	6.9	1.7
Erie	713	92	102	29.29	30.07	+ .02	53.8	+ 1.6	80	7	60	35	26	47	26	48	44	74	3.70	— 0.4	15	8,946	sw.	37	n.	25	9	8	14	6.2	0.2
Cleveland	762	190	201	29.26	30.09	+ .03	54.0	+ 1.8	78	7	60	36	25	48	25	49	45	77	3.48	+ 0.6	11	12,627	s.	48	nw.	17	10	10	11	5.1	T.
Sandusky	629	62	70	29.41	30.10	+ .04	55.0	+ 1.8	79	3	62	28	27	48	24	......	......	......	2.04	— 0.7	7	6,801	sw.	34	nw.	17	18	6	7	3.5	T.
Toledo	628	120	127	29.41	30.10	+ .05	53.6	+ 1.5	79	3	62	27	27	45	27	47	42	71	2.32	— 0.1	6	7,248	sw.	38	s.	7	18	4	9	4.0	T.
Detroit	730	153	193	29.28	30.07	+ .02	53.1	+ 2.1	75	7	61	28	27	45	25	47	44	78	1.67	— 0.9	7	8,807	sw.	41	s.	7	13	7	11	4.7	T.
Upper Lake Region.							49.6	+ 2.5										76	2.35	— 0.6										4.7	
Alpena	609	63	80	29.37	30.04	+ .01	47.8	+ 2.6	72	29	57	26	24	39	30	43	40	79	2.73	— 1.1	8	8,052	nw.	36	nw.	25	13	5	13	5.4	T.
Escanaba	612	40	48	29.36	30.04	+ .03	47.0	+ 2.3	65	3	56	26	27	38	34	43	40	80	1.75	— 1.6	7	5,684	sw.	30	nw.	22	19	8	4	3.1	T.
Grand Rapids	707	127	165	29.30	30.08	+ .05	51.5	+ 0.7	81	3	60	27	27	43	27	46	43	79	2.31	— 0.4	7	7,900	sw.	38	sw.	3	12	11	8	4.7	T.
Houghton	668	66	74	29.27	30.00	.00	48.1	......	73	3	56	31	24	40	38	......	......	......	3.52	......	10	5,781	nw.	44	w.	4	15	7	9	4.5	T.
Marquette	734	79	116	29.21	30.02	+ .01	49.4	+ 4.3	74	29	57	31	23	42	33	42	36	66	2.30	— 1.0	10	8,935	w.	48	sw.	3	11	12	8	5.1	0.5
Port Huron	638	70	120	29.39	30.08	+ .04	51.4	+ 2.5	76	7	60	26	27	43	28	46	42	77	2.16	— 0.6	6	9,015	sw.	42	s.	7	13	9	9	4.6	T.
Sault Ste. Marie	614	40	61	29.32	30.00	— .01	45.8	+ 3.1	66	3	54	29	23	37	26	42	38	79	3.49	0.0	12	6,561	nw.	45	w.	25	7	11	13	6.3	0.3
Chicago	823	241	274	29.21	30.10	+ .06	53.6	+ 1.6	83	3	60	33	27	48	23	48	42	70	1.09	— 1.8	7	12,468	w.	50	s.	7	17	7	7	4.0	
Milwaukee	681	124	142	29.34	30.08	+ .05	52.0	+ 2.8	82	3	60	31	27	44	25	47	43	80	2.13	— 0.2	5	7,469	sw.	39	s.	6	14	6	11	4.7	
Green Bay	617	49	86	29.39	30.06	+ .04	48.8	+ 1.9	81	3	59	26	23	39	32	43	40	78	1.72	— 1.0	6	7,443	sw.	42	sw.	3	13	8	10	5.0	
Duluth	702	95	116	29.24	30.02	+ .02	48.4	+ 3.5	73	19	56	30	26	41	36	42	36	69	3.84	+ 1.2	11	7,567	sw.	39	nw.	22	13	12	6	4.5	T.

TABLE I.—*Climatological data for Weather Bureau stations, October, 1903*—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Actual, reduced to mean of 24 hours.	Pressure, in inches: Sea level, reduced to mean of 24 hrs.	Pressure, in inches: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. + mean min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
North Dakota.							**47.4**	**+ 4.0**										**68**	**1.33**	**0.0**										**3.8**	
Moorhead	935	54	60	28.99	30.03	+ .03	47.2	+ 4.1	71	19	58	24	26	36	38	41	37	78	3.66	+ 1.7	7	8,578	se.	48	se.	10	14	7	10	4.5	0.6
Bismarck	1,674	16	29	28.23	30.02	+ .03	49.0	+ 5.2	80	10	62	23	17	36	44	39	32	62	0.27	− 0.8	4	7,683	nw.	53	nw.	7	15	12	4	3.9	
Williston	1,875	14	44	27.98	29.98	.00	46.0	+ 2.8	71	18	60	21	17	32	46	37	31	64	0.05	− 0.9	2	7,271	nw.	51	nw.	21	21	5	5	3.1	
Upper Miss. Valley.							**54.6**	**+ 1.9**										**74**	**2.39**	**0.0**										**3.7**	
Minneapolis	....	99	208	....	....		50.0	+ 2.1	73	19	58	30	26	42	33			....	4.36	+ 2.6	9	8,879	w.	45	w.	3	11	11	9	....	
St. Paul	837	102	122	29.13	30.04	+ .03	50.4	+ 3.3	76	19	59	31	26	42	36	44	39	74	5.41	+ 3.5	7	5,897	se.	36	sw.	3	16	8	7	4.4	
La Crosse	714	71	87	29.31	30.08	+ .06	51.8	+ 2.3	77	3	60	32	24	43	29	....	....	....	1.51	− 0.7	6	5,519	s.	36	w.	6	18	5	8	4.0	T.
Davenport	606	71	79	29.42	30.07	+ .03	54.2	+ 2.1	82	3	63	32	26	45	27	47	43	73	2.27	− 0.4	7	5,197	sw.	34	w.	6	15	9	7	3.6	
Des Moines	861	84	99	29.17	30.12	+ .09	53.8	+ 1.6	82	3	65	29	24	43	39	46	41	73	1.32	− 1.7	6	6,281	nw.	42	sw.	3	13	10	8	4.7	
Dubuque	698	100	117	29.34	30.10	+ .06	52.4	+ 1.8	81	3	62	28	27	43	30	45	41	73	1.72	− 1.0	5	4,546	nw.	30	nw.	17	18	9	4	3.6	
Keokuk	614	63	78	29.42	30.08	+ .03	55.6	+ 1.5	84	3	64	32	27	47	28	49	46	80	3.23	+ 0.5	5	5,107	sw.	36	w.	6	19	8	4	2.7	
Cairo	356	87	93	29.74	30.12	+ .05	60.0	+ 1.3	86	3	70	35	25	50	36	53	49	75	1.98	− 0.8	5	5,662	n.	32	s.	7	12	14	5	4.3	
Springfield, Ill.	644	82	93	29.42	30.11	+ .06	56.2	+ 1.2	86	3	66	29	27	46	30	49	44	71	1.50	− 1.2	5	6,295	s.	38	s.	6	11	11	9	4.3	
Hannibal	534	75	110	29.52	30.10	+ .05	56.6	+ 1.6	85	3	66	27	27	47	36	....	....	....	1.65	+ 0.2	4	6,295	sw.	37	sw.	6	19	11	1	2.5	
St. Louis	567	208	217	29.49	30.09	+ .03	59.2	+ 1.7	87	3	68	35	24	51	34	53	48	75	1.37	− 1.5	7	7,427	se.	38	nw.	7	17	9	5	3.3	
Missouri Valley.							**55.3**	**+ 2.7**										**64**	**2.16**	**+ 0.2**										**3.8**	
Columbia, Mo.	784	11	84	29.25	30.08	+ .03	57.0	− 0.6	86	2	68	26	24	46	39	....	....	....	2.41	+ 0.3	7	5,373	se.	31	nw.	7	17	5	9	4.1	
Kansas City	963	78	95	29.08	30.12	+ .08	58.2	+ 2.5	85	2	67	38	24	49	30	49	43	66	3.86	+ 0.5	8	5,374	se.	30	s.	3	18	5	8	3.5	
Springfield, Mo	1,324	98	104	28.70	30.11	+ .06	58.4	+ 2.4	84	2	67	35	18	50	33	51	46	73	4.57	+ 1.5	8	7,427	se.	35	s.	6	19	6	6	3.3	
Topeka	....	81	89	....	....		57.0	+ 1.0	85	2	68	35	23	46	37	....	....	....	3.50	+ 1.5	8	5,870	s.	32	sw.	6	15	8	8	4.1	
Lincoln	1,189	75	84	28.79	30.06	+ .03	55.6	+ 1.5	86	2	67	31	27	44	40	46	40	66	2.90	+ 0.9	10	7,888	n.	49	nw.	7	18	6	7	3.6	
Omaha	1,105	115	121	28.89	30.08	+ .05	56.4	+ 3.5	85	19	66	36	27	46	37	47	40	63	1.19	− 1.3	9	6,503	s.	34	nw.	7	15	9	7	4.3	
Valentine	2,598	47	54	27.31	30.04	+ .03	52.6	+ 3.4	83	2	67	22	31	38	46	42	35	61	0.22	− 0.7	3	8,666	nw.	57	nw.	7	18	8	5	3.6	
Sioux City	1,135	96	164	28.85	30.07	+ .05	53.8	+ 2.8	84	19	65	31	26	42	40	....	....	....	3.24	+ 1.5	6	9,628	se.	58	w.	7	16	7	8	4.1	
Pierre	1,572	43	50	28.38	30.06	+ .05	54.0	+ 4.6	87	10	68	28	23	40	48	42	34	57	0.25	− 0.4	6	5,912	e.	48	nw.	7	15	11	5	3.7	
Huron	1,306	56	67	28.64	30.06	+ .05	51.0	+ 4.5	82	2	66	24	31	36	49	41	34	65	0.34	− 0.9	4	9,938	nw.	55	s.	10	12	10	9	4.5	
Yankton	1,233	42	49	28.72	30.04	+ .03	53.8	+ 4.1	86	18	67	32	5	40	52	....	....	....	1.23	− 0.2	5	6,020	nw.	42	w.	7	20	8	3	3.5	
Northern Slope.							**50.1**	**+ 4.1**										**62**	**0.35**	**− 0.5**										**3.5**	
Havre	2,505	46	53	27.36	30.00	+ .02	49.8	+ 5.8	79	23	65	20	22	35	52	41	34	62	0.21	− 0.4	4	7,736	sw.	42	sw.	6	22	6	3	3.1	T.
Miles City	2,371	42	50	27.51	30.04	+ .04	50.8	+ 4.7	80	18	65	26	26	36	44	44	41	81	0.32	− 0.5	2	4,231	s.	48	w.	6	25	5	1	2.3	
Helena	4,110	88	94	25.88	30.08	+ .05	50.7	+ 5.5	75	18	61	29	4	40	33	39	29	48	0.28	− 0.6	6	5,860	sw.	48	sw.	6	12	12	7	4.4	T.
Kalispell	2,965	45	51	27.01	30.09	+ .08	44.4	....	71	19	56	23	31	33	40	39	34	73	1.11	....	11	3,507	w.	30	w.	28	13	12	6	4.5	T.
Rapid City	3,234	46	50	26.66	30.04	+ .03	51.8	+ 2.8	81	10	65	28	31	38	40	41	33	56	0.30	− 0.4	2	6,131	w.	40	nw.	7	20	7	4	2.8	
Cheyenne	6,088	56	64	24.11	30.10	+ .09	47.1	+ 2.2	75	9	60	21	31	34	39	36	25	50	0.34	− 0.4	5	7,563	nw.	48	nw.	6	17	9	5	3.2	1.5
Lander	5,372	26	36	24.75	30.16	+ .12	46.6	+ 3.1	78	18	63	19	31	30	49	37	30	64	0.57	− 0.4	6	2,563	sw.	30	sw.	10	19	7	5	3.2	0.6
North Platte	2,821	43	52	27.16	30.10	+ .08	54.1	+ 4.3	89	2	70	28	16	39	50	43	36	64	0.44	− 0.5	3	6,252	w.	38	nw.	6	17	12	2	3.0	
Middle Slope.							**56.8**	**+ 1.4**										**60**	**2.47**	**+ 0.9**										**3.6**	
Denver	5,291	79	151	24.82	30.09	+ .08	52.6	+ 2.1	84	10	66	21	31	39	42	40	30	51	1.34	+ 0.4	6	5,918	s.	42	sw.	2	18	9	4	3.3	4.4
Pueblo	4,685	80	86	25.38	30.08	+ .09	52.8	+ 0.6	86	10	69	25	31	37	53	39	26	44	0.93	+ 0.2	5	5,128	nw.	38	n.	14	20	8	3	2.8	2.0
Concordia	1,398	42	47	28.60	30.09	+ .06	56.8	+ 2.3	87	19	69	31	23	45	46	48	42	70	2.88	+ 0.8	8	5,296	s.	30	nw.	7	19	6	6	3.4	
Dodge	2,509	44	54	27.47	30.08	+ .06	57.4	+ 2.3	90	19	72	27	23	43	50	46	38	61	1.28	0.0	7	7,833	se.	44	se.	10	17	6	8	4.0	
Wichita	1,358	78	86	28.65	30.08	+ .05	59.2	+ 1.6	85	2	70	35	23	48	38	50	45	70	5.96	+ 3.6	8	5,343	se.	26	s.	6	20	4	7	3.9	
Oklahoma	1,214	79	86	28.78	30.06	+ .03	61.8	− 0.2	89	4	72	38	18	52	38	52	45	65	2.41	+ 0.3	4	7,857	se.	48	nw.	31	17	5	9	4.1	
Southern Slope.							**60.8**	**+ 0.4**										**64**	**1.50**	**− 0.5**										**3.8**	
Abilene	1,738	45	54	28.26	30.06	+ .05	63.4	− 1.1	85	4	74	35	24	52	34	54	49	70	0.42	− 1.9	7	5,648	se.	30	nw.	15	17	8	6	4.0	
Amarillo	3,676	10	49	26.32	30.04	+ .04	58.1	+ 1.9	86	2	71	31	16	45	41	46	37	57	2.58	+ 0.9	5	10,458	s.	42	s.	6	19	8	4	3.6	
Southern Plateau.							**61.7**	**+ 1.3**										**37**	**0.29**	**− 0.4**										**0.8**	
El Paso	3,762	10	110	26.24	29.99	+ .07	62.9	− 0.1	89	2	78	37	25	48	41	46	33	42	0.00	− 0.9	0	6,273	e.	43	w.	30	30	1	0	0.5	
Santa Fe	7,013	47	50	23.35	30.05	+ .09	51.2	+ 1.4	73	9	63	27	31	39	34	36	22	37	0.02	− 1.0	1	4,354	se.	34	sw.	2	28	3	0	1.0	
Flagstaff	6,907	12	25	23.45	30.03	+ .11	47.0	− 1.5	72	7	64	14	31	30	43	38	....	....	1.04	− 0.1	2	....	e.	....	....	....	26	4	1	1.1	....
Phoenix	1,108	50	56	28.80	29.94	+ .06	71.0	+ 1.2	95	8	88	44	31	54	40	54	40	39	0.22	− 0.2	2	2,675	e.	20	e.	17	30	1	0	0.5	
Yuma	141	16	46	29.76	29.91	+ .04	74.8	+ 2.0	96	*	91	51	30	59	41	56	42	39	0.04	− 0.2	2	3,561	ne.	27	n.	11	30	1	0	0.3	
Independence	3,910	51	58	26.06	30.03	+ .08	63.5	+ 4.8	84	20	76	44	3	51	34	46	27	27	0.42	+ 0.1	1	4,700	nw.	31	se.	9	27	3	1	1.5	
Middle Plateau.							**50.8**	**+ 2.0**										**46**	**0.34**	**− 0.6**										**2.6**	
Carson City	4,720	82	92	25.38	30.08	+ .09	52.4	+ 2.8	80	19	70	23	30	35	50	41	31	51	0.03	− 0.4	2	3,757	sw.	36	s.	9	16	11	4	3.3	
Winnemucca	4,344	59	70	25.72	30.12	+ .07	51.1	+ 2.9	82	18	69	23	30	34	54	40	28	46	0.47	0.0	4	6,090	ne.	56	w.	9	20	4	7	3.0	
Modena	5,479	10	43	24.74	30.10	+ .14	50.0	....	74	18	66	17	31	34	42	38	24	43	1.39	....	3	6,357	w.	42	sw.	9	27	2	2	1.4	
Salt Lake City	4,366	105	110	25.74	30.13	+ .12	53.2	+ 0.9	77	9	63	32	31	43	28	42	31	45	0.81	− 0.7	6	3,929	se.	36	sw.	10	21	5	5	2.6	
Grand Junction	4,608	43	51	25.48	30.09	+ .10	54.3	+ 1.5	80	10	69	28	31	40	40	41	28	43	0.07	− 1.1	4	3,213	nw.	26	sw.	6	21	9	1	2.6	
Northern Plateau.							**52.0**	**+ 2.0**										**61**	**0.94**	**+ 0.3**										**3.9**	
Baker City	3,471	53	59	26.56	30.17	+ .09	49.6	+ 1.5	72	23	62	24	30	38	36	40	32	56	1.14	0.0	6	3,661	se.	22	nw.	6	14	6	11	4.5	
Boise	2,739	61	68	27.29	30.17	+ .11	53.5	+ 4.1	78	9	66	29	30	41	34	44	36	57	1.06	0.0	7	2,335	se.	25	sw.	9	18	6	7	3.7	
Lewiston	757	52	61	29.30	30.12	+ .05	53.9	+ 1.1	74	13	66	32	30	42	34	....	....	....	1.05	− 0.2	8	2,015	w.	30	w.	13	21	4	6	3.0	
Pocatello	4,482	46	54	25.60	30.15	+ .11	50.4	+ 2.4	77	18	64	20	30	36	44	39	29	50	0.33	− 0.7	7	5,317	e.	36	sw.	6	17	9	5	3.1	T.
Spokane	1,929	101	110	28.05	30.13	+ .07	49.2	+ 1.2	72	18	61	28	30	37	38	43	36	65	0.79	− 0.8	5	3,749	ne.	40	sw.	5	8	11	12	5.6	
Walla Walla	1,000	65	71	29.03	30.11	+ .04	55.4	+ 1.4	77	19	66	32	31	45	35	51	48	78	1.29	− 0.2	6	3,319	se.	30	sw.	5	16	11	4	3.7	
N. Pac. Coast Reg.							**53.1**	**+ 1.8**										**83**	**2.92**	**− 1.6**										**5.8**	
North Head	211	11	56	29.85	30.07	+ .02	54.9	+ 1.5	77	22	59	46	14	51	22	52	51	88	4.55	− 0.8	14	11,031	se.	73	s.	5	5	5	21	7.2	
Port Crescent	259	12	29	29.78	30.07	+ .05	48.4	+ 0.8	62	16	55	34	*	42	20	....	....	....	2.94	− 0.7	11	3,718	w.	16	w.	5	11	12	8	4.9	
Seattle	123	114	151	29.96	30.09	+ .04	53.6	+ 2.1	68	17	59	39	30	48	25	50	47	80	1.94	− 1.0	9	4,649	se.	36	sw.	5	11	10	10	5.1	
Tacoma	213	113	120	29.86	30.10	+ .06	52.2	+ 1.6	66	12	59	33	30	46	24	....	....	....	2.72	− 1.3	10	3,787	n.	36	sw.	5	7	12	12	6.2	
Tatoosh Island	86	7	57	29.93	30.03	+ .02	52.0	+ 1.6	61	26	56	43	3	48	12	50	48	88	5.33	− 3.2	14	13,475	e.	78	sw.	5	6	8	17	6.7	
Portland, Oreg.	154	68	96	29.92	30.08	+ .02	55.6	+ 2.2	77	22	64	38	31	47	31	51	48	79	2.20	− 1.9	9	3,458	nw.	30	s.	5	7	10	14	6.4	
Roseburg	518	56	67	29.52	30.09	+ .01	55.2	+ 2.5	79	17	66	38	1	45	37	51	47	79	0.79	− 2.0	7	1,857	w.	15	sw.	10	17	8	6	3.8	
Mid. Pac. Coast Reg.							**61.6**	**+ 3.4**										**70**	**0.70**	**− 1.0**										**4.1**	
Eureka	62	62	80	30.03	30.09	+ .03	54.6	+ 2.5	72	15	59	42	1	50	23	52	50	88	2.42	− 0.5	8	3,401	sw.	29	n.	6	5	10	16	7.0	
Mount Tamalpais	2,375	11	18	27.61	30.06	+ .05	64.1	....	86	19	70	43	1	58	22	52	42	53	0.36	....	3	10,603	nw.	62	nw.	6	20	8	3	2.5	
Red Bluff	332	50	56	29.67	30.01	− .02	67.6	+ 4.1	92	17	81	46	2	54	38	54	42	46	0.46	− 0.9	5	2,663	n.	27	n.	11	21	7	3	2.5	
Sacramento	69	106	117	29.94	30.00	+ .01	66.2	+ 4.4	90	16	80	44	2	52	34	56	48	58	0.12	− 0.8	1	4,521	se.	27	sw.	9	23	6	2	2.0	
San Francisco	155	161	167	29.90	30.07	+ .06	62.0	+ 2.7	85	12	69	51	21	55	28	56	53	82	0.17	− 1.0	2	5,963	w.	30	s.	9	17	12	2	3.0	
Point Reyes Light	490	7	50	29.49	30.01	....	57.4	+ 3.3	78	12	62	49	22	52	24	....	....	....	0.33	− 2.0	2	11,815	nw.	60	s.	9	11	3	17	6.0	
Southeast Farallon	30	9	17	30.02	30.06	....	57.2	....	80	12	59	51	22	55	22	56	56	96	0.14	....	3	9,215	nw.	48	s.	9	8	13	10	6.0	
S. Pac. Coast Reg.							**65.3**	**+ 1.8**										**68**	**0.02**	**− 0.6**										**2.0**	
Fresno	330	67	70	29.65	30.00	+ .04	67.7	+ 2.8	95	18	83	46	3	52	39	54	43	48	0.00	− 0.5	0	2,617	nw.	11	nw.	28	28	2	1	1.4	
Los Angeles	338	116	123	29.63	30.00	+ .05	66.3	+ 2.6	97	18	79	45	28	54	39	56	50	70	T.	− 0.7	0	3,395	w.	20	sw.	10	22	7	2	2.3	
San Diego	87	94	102	29.88	29.98	+ .03	63.5	+ 0.3	84	12	70	51	24	57	27	59	56	83	0.07	− 0.3	2	3,920	nw.	20	nw.	17	26	3	2	2.0	
San Luis Obispo	201	46	48	29.83	30.06	+ .07	63.6	+ 1.6	97	13	77	41	19	50	45	54	50	72	0.02	− 1.0	1	3,346	n.	25	n.	11	24	4	3	2.4	
West Indies.																															
Basseterre	29	41	54	29.89	29.91	+ .01	80.7	....	89	8	86	71	18	76	15	75	72	76	6.66	....	19	5,843	e.	32	se.	16	8	16	7	5.1	
Bridgetown	30	57	65	29.88	29.90	+ .02	80.2	+ 1.8	88	11	85	72	17	75	14	75	73	79	6.51	− 1.1	24	5,240	e.	22	e.	29	9	9	13	5.9	
Cienfuegos	52	62	67	29.86	29.92	+ .04	76.9	....	89	13	85	57	26	68	23	71	69	84	2.08	....	11	4,848	ne.	19	ne.	4	11	14	6	5.1	
Havana	57	87	105	29.89	29.95	+ .05	77.2	− 0.9	89	13	82	66	26	72	20	....	....	....	4.67	− 2.8	10	8,949	e.	38	ne.	30	6	16	9	5.7	
Kingston	286	41	55	29.58	29.87	+ .02	80.0	....	90	13	87	65	31	73	22	....	....	....	2.28	....	10	....	nw.	....	....	....	1	23	7	6.6	
Puerto Principe	352	55	62	29.57	29.93	+ .05	77.2	....	91	17	85	62	11	69	23	73	72	90	5.86	....	18	4,131	ne.	24	e.	4	10	13	8	5.3	
San Juan	82	48	90	29.83	29.92	+ .02	80.4	0.0	91	10	87	68	21	74	17	75	73	80	5.87	− 0.3	18	6,108	se.	38	w.	21	9	16	6	5.0	
Santiago de Cuba	82	46	52	29.81	29.89	+ .01	79.0	....	91	13	87	67	21	71	20	73	72	84	4.23	....	10	4,128	n.	24	s.	10	5	22	4	5.5	
Santo Domingo	57	37	44	29.85	29.91	+ .02	78.8	....	88	2	86	68	23	72	18	74	73	85	5.27	....	12	4,006	n.	16	sw.	10	8	14	9	5.4	

* More than one date.

TABLE II.—*Climatological record of voluntary and other cooperating observers, October, 1903.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Temperature. (Fahrenheit.) Minimum.	Temperature. (Fahrenheit.) Mean.	Precipitation. Rain and melted snow.	Precipitation. Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Anniston	92[e]	30[e]	65.4[e]	1.94	
Ashville	90	27	59.8	2.84	
Bridgeport				2.23	
Burkeville				1.65	
Calera				2.26	
Camphill	95	33	65.8	0.98	
Citronelle	92	38	68.5	1.09	
Clanton	92	32	63.3	1.50	
Cordova	94	23	61.5	4.36	
Daphne	90[i]	39[i]	68.9[i]	0.65	
Decatur	93	36	63.2	2.73	
Demopolis				0.72	
Dothan	91	34	67.2	0.72	
Eufaula	86	34	62.9	1.13	
Evergreen	90	32	64.1	2.19	
Flomaton	92	31	64.2	3.68	
Florence *a*				1.12	
Florence *b*	97	26	61.8	1.26	
Fort Deposit	89	32	63.8	0.93	
Gadsden	95	30	62.1	3.54	
Goodwater	91	32	62.2	1.46	
Greensboro	90	35	64.4	0.85	
Greenville				0.50	
Haleysville	92	40	63.5	2.30	
Hamilton	97	23	61.8	1.49	
Helena				3.10	
Highland Home	88	36	65.0	1.46	
Letohatchie				1.54	
Livingston	90	31	62.5	2.23	
Lock No. 4	95	28	63.3	2.26	
Madison Station	92			4.17	
Maplegrove	92	25	61.2	2.50	
Marion	90	34	64.2	0.60	
Milstead				1.36	
Newbern	96	30	63.6	0.97	
Notasulga				1.84	
Oneonto	93	24	60.3	2.76	
Opelika	85	32	62.6	1.39	
Ozark	90	31	65.6	0.50	
Prattville	91	30	63.5	1.89	
Pushmataha	89	30	64.0	1.08	
Riverton	94	23	61.1	0.74	
Scottsboro				2.20	
Selma	92	35	64.0	1.08	
Talladega	97	27	64.5	2.12	
Tallassee				1.52	
Thomasville	92	33	64.6	1.52	
Tuscaloosa	92	30	62.4	3.43	
Tuscumbia	90	29	60.6	1.04	
Tuskegee	95	32	67.0	1.79	
Union Springs	87	32	63.8	2.23	
Uniontown	92	29	63.4	0.63	
Valleyhead	91	22	60.2	2.60	
Verbena				1.20	
Wetumpka	94	30	65.8	1.88	
Alaska.					
Fort Liscum	50	16	33.6	6.62	28.6
Killisnoo	55	26	43.0	12.45	
Orca	54	28	39.6	17.70	14.0
Sitka	57	30	45.1	14.52	
Skagway	55	22	40.6	9.90	13.5
Arizona.					
Agua Caliente	97	41	71.8	0.00	
Allaire Ranch				0.00	
Arizona Canal Co's Dam	95	46	72.2	0.00	
Aztec	103	49	77.4	0.00	
Benson	92	33	63.8	0.00	
Bowie	88	30	62.0	0.00	
Buckeye	98[j]	40[j]	67.8[j]	0.00	
Casagrande	98	45	72.1	0.00	
Cochise *[1]	80	38	61.3	0.00	
Congress	86	52	71.8	0.00	
Dragoon *[1]	85	32	58.1	0.00	
Dudleyville	92	37	64.9	0.00	
Duncan	90	18	56.4	0.00	
Fort Apache	83	20	54.1	0.00	
Fort Defiance	70	18	45.6	0.00	
Fort Grant	85	46	64.8	0.00	
Fort Huachuca	86	58	69.2	0.00	
Fort Mohave	98	41	72.0	0.50	
Gilabend	100	55	78.4	0.00	
Grand Canyon	74[e]	30[e]	49.7[e]	0.02	
Holbrook	85	22	54.4	0.00	
Jerome	79	43	63.4	0.20	
Kingmans	87	41	66.0	0.20	
Maricopa	91	38	68.0	0.00	
Mellen	95	44	71.7	T.	
Mesa	97	43	70.2	0.00	
Mesa (near)	95	37	67.0	0.00	
Mohawk Summit *[1]	96	58	76.6	0.00	
Natural Bridge				0.15	
Nogales	89	40	64.1	0.00	
Oracle	82	40	64.3	0.00	
Oro				0.00	
Parker	103	36	72.2	T.	
Phoenix	96	37	68.8	T.	
Pinal Ranch				0.00	
Prescott	78	15	49.0	0.10	T.
Arizona—Cont'd.	°	°	°	*Ins.*	*Ins.*
St. Johns	85	21	52.2	0.00	
San Carlos	97	32	64.6	0.00	
San Simon	89	26	60.2	0.00	
Sentinel *[1]	98	55	73.2	0.00	
Signal	99	37	69.6	0.52	
Silver King				0.00	
Superstition				0.00	
Taylor	80	20	51.8	0.00	
Thatcher	95	26	62.8	0.00	
Tombstone	88	39	64.8	0.00	
Tonto	90	36	66.0	0.00	
Tucson	93	35	67.4	0.00	
Upper San Pedro	89	30	60.6	0.00	
Vail *[b]	88	60	70.0	0.00	
Walnutgrove				0.00	
Wilcox	90	24	57.2	0.00	
Williams	80	19	52.0	0.36	
Yarnell				0.03	
Young	87	21	56.3	0.00	
Arkansas.					
Alco	87	31	61.8	2.20	
Amity	90	32	60.8	4.11	
Arkadelphia	90	32	62.3	3.83	
Arkansas City				0.76	
Batesville	86	32	60.3	2.86	
Beebranch	88[g]	32[g]	60.0[g]	3.55	
Blanchard	90	28	61.8	0.94	
Brinkley	91	26	60.2	0.28	
Camden *a*				1.57	
Camden *b*	92	36	63.8	1.68	
Conway	89	32	61.9	2.75	
Corning	88	28	58.4	3.80	
Dallas	85	34	60.2	1.41	
Dardanelle				2.25	
De Queen	92	33	64.4	1.38	
Des Arc	90	28	61.0	0.89	
Dodd City	87	27	58.8	2.00	
Dutton	81	30	58.3	2.50	
Eureka Springs	86	31	59.2	3.62	
Fayetteville	78	29	55.8	4.85	
Forrest City	89	28	63.6	0.53	
Fulton				3.28	
Hardy	89	31	59.8	1.97	
Helena *a*				0.32	
Helena *b*	90	30	62.3	0.24	
Jonesboro	92	28	62.4	3.06	
Lacrosse	88[c]	32[c]	59.4[c]	1.24	
Lake Village	90	31	63.7	0.83	
Lonoke	93	27	61.0	1.32	
Lutherville	90	29	60.0	2.66	
Malvern	90	31	60.9	2.60	
Marvell	93	27	62.9	0.52	
Mossville	81	33	57.6	5.07	
Mount Nebo	82	39	60.2	2.73	
New Gascony	92	28	61.8	T.	
Newport *a*				3.68	
Newport *b*	90	31	61.6	3.66	
Oregon	86	27	57.1	2.22	
Ozark	91	33	61.3	2.81	
Paragould	91	29	61.0	2.27	
Perry	88	33	60.8	2.18	
Pinebluff	91	28	61.0	1.05	
Pocahontas	90	28	60.1	4.26	
Pond	84	27	58.1	3.42	
Prescott	95	34	64.4	2.57	
Princeton	91	29	61.6	1.68	
Rison	89[h]	26[h]	59.4[h]	1.34	
Rosadale	91	33	63.0	2.01	
Russellville	87	31	58.7	4.10	
Silversprings	85	28	59.1	3.10	
Spielerville	88	35	61.6	1.83	
Stuttgart	92	27	61.0	1.20	
Texarkana	97	35	64.0	2.90	
Warren	93	27	62.8	0.88	
Washington	92	35	63.9	2.38	
Wiggs	88	29	60.2	4.87	
Winchester	92[d]	33[d]	63.6[d]	0.81	
Winslow	79	33	58.0	3.89	
Witts Springs	84	33	59.0	1.02	
California.					
Angiola	98	39	65.7	0.00	
Azusa	102	40	68.1	0.00	
Bagdad	95	53	73.9	0.00	
Bakersfield	96	40	65.6	0.00	
Ballast Point L. H.				0.10	
Barstow	92	36	65.0	0.00	
Bear Valley				3.10	
Berkeley	83	47	60.0	0.50	
Bishop	90[f]	27[f]	59.6[f]	0.21	
Bodie	69	6	39.2	0.00	
Branscomb	87	33	59.5	3.94	
Brush Creek	82	32	58.4	1.77	
Caliente *[1]	98	55	71.9	0.00	
Campbell	89	37	61.6	0.12	
Campo				0.03	
Cape Mendocino L. H.				3.60	
Cedarville	83	22	52.2	0.33	
Chico	95	41	69.2	0.45	
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Claremont	101	42	69.6	0.02	
Cloverdale	95	39	66.4	1.22	
Coachella	108	45	77.6	0.00	
Colusa	87	43	65.2	0.17	
Coronado	85	50	63.2	0.16	
Crescent City	82	37	54.8	3.96	
Crescent City L. H.				3.10	
Cuyamaca	70	28	51.0	0.53	
Drytown	89	40	63.4	0.10	
Durham	96	37	65.9	0.52	
E. Brother L. H.				0.15	
Elcajon	103	40	65.8	0.20	
Elmdale	99	38	65.0	T.	
Elsinore	109	33	68.0	0.05	
Escondido	95	30	60.4	0.12	
Fallbrook	97	39	64.0	0.11	
Fordyce Dam				2.75	
Fort Ross	73	44	57.0	1.27	
Foster				0.18	
Georgetown	87	37	63.9	1.39	
Gilroy (near)	100	37	63.6	0.05	
Greenville	86	40	64.0	0.99	
Hanford	96	40	65.8	0.05	
Healdsburg	97	35	64.6	1.00	
Hollister	97	38	63.2	0.02	
Humboldt L. H.				2.57	
Idylwild	81	31	55.6	0.47	
Imperial	99	48	74.2	T.	
Indio	105	50	81.6	0.00	
Iowa Hill *[1]	83	46	62.9	1.38	
Jackson	92	43	67.4	0.47	
Jamestown	90	43	64.3	T.	
Jolon				0.02	
Kennedy Gold Mine	82	36	60.0	0.00	
Kernville				0.00	
Kentfield	85[d]	40[d]	61.4[d]	1.74	
Laguna Valley				0.00	
Lakeport (near)	79	49	63.4	0.36	
Laporte	73	29	51.8	3.50	T.
Legrande	95	36	65.8	0.00	
Lemoncove	101	40	73.0	0.02	
Lick Observatory	80	35	59.8	0.39	
Lime Point, L. H.				0.14	
Livermore	95	41	65.8	T.	
Lodi	88	38	62.5	0.03	
Los Gatos	89	43	63.2	0.84	
Mare Island L. H.				0.07	
Merced	98	30	61.7	0.00	
Mercury				1.45	
Mills College				0.52	
Milo				0.00	
Milton (near)	92	46	67.6	0.02	
Mokelumne Hill				0.31	
Montague	84	25	55.2	0.70	
Monterio	82	40	62.6	0.00	
Mount St. Helena				2.00	
Napa	97	40	64.6	0.44	
Needles	93	57	77.7	0.07	
Nevada City	91	33	60.5	1.49	
Newcastle	94	42	66.8	0.35	
Newman	99	42	69.0	T.	
Niles	88	42	63.0	0.13	
Nimshew	81	36	60.1	1.73	
North Bloomfield	87	32	59.8	2.13	
North San Juan	89	35	58.5	1.56	
Oakland	81	50	61.9	0.31	
Ontario (near)	96	43	67.0	0.00	
Orleans	89	38	64.4	2.06	
Oroville (near)	96	47	67.8	0.65	
Palermo	95	37	64.0	0.55	
Peachland *[b]	86	41	62.9	1.11	
Piedras Blancas L. H.				0.32	
Pigeon Point L. H.				0.15	
Pilot Creek				1.89	
Pine Crest	95	48	67.8	0.00	
Placerville	82	34	58.0	0.73	
Point Ano Nuevo L. H.				0.35	
Point Arena L. H.				1.30	
Point Bonita L. H.				1.03	
Point Conception L. H.				0.00	
Point Fermin L. H.				0.15	
Point Hueneme L. H.				0.00	
Point Lobos	80	49	57.6	0.10	
Point Loma L. H.				0.10	
Point Montara L. H.				0.75	
Point Pinos L. H.				0.00	
Point Sur L. H.				0.25	
Porterville	96	42	68.0	0.00	
Poway				0.14	
Quincy	74	27	50.9	1.53	
Ranch House	94	48	66.0	0.14	
Redding	90	47	67.7	1.14	
Redlands	97	45	69.4	0.06	
Reedley	97	40	67.3	0.00	
Represa	80	48	63.0	0.19	
Riovista	88	49	66.8	0.05	
Riverside	97	41	65.8	0.05	
Roe Island L. H.				0.13	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Rohnerville				2.52	
Rosewood	91	34	62.5	0.27	
Sacramento	81	43	61.6	0.15	
Salinas	93	40	61.0	0.00	
San Bernardino	100	37	67.0	0.07	
San Jacinto	96	44	67.8	0.00	
San Jose	90	42	63.7	0.12	
San Leandro	85	44	61.4	0.31	
San Luis L. H.				0.00	
San Rafael	91	41	63.2	1.03	
Santa Barbara	95	48	64.8	T.	
Santa Barbara L. H				0.00	
Santa Clara				0.05	
Santa Clara College	92	37	63.2	0.12	
Santa Cruz	90	40	60.1	0.65	
Santa Cruz L. H.				0.30	
Santa Maria	95	38	63.7	T.	
Santa Monica	90	45	62.9	0.00	
Santa Paula	100	47	72.4	0.00	
Santa Rosa	93	36	63.0	0.64	
Shasta	92	46	69.2	2.05	
Sierra Madre	91	47	67.4	0.02	
Sonoma				0.34	
S. E. Farallon L. H.				0.22	
Stockton	87	42	63.6	0.05	
Storey	96	39	64.8	0.00	
Summerdale	81	33	58.0	0.66	
Susanville	76	25	51.2	0.52	
Tejon Ranch	89	50	69.0	0.00	
Trinidad L. H				3.22	
Tulare c	100	40	66.8	0.03	
Tustin	92	60	71.6	0.09	
Ukiah	91	34	62.4	0.90	
Upland	93	43	66.8	0.00	
Upperlake	92	32	61.4	0.65	
Upper Mattole *[1]	84	35	56.1	7.87	
Vacaville *[1]	96	47	67.1	0.50	
Visalia	98	40	66.2	0.00	
Wasco	97	43	66.5	0.00	
Westpoint				0.46	
Wheatland	87	41	63.8	0.24	
Willits	92	38	61.3	2.52	
Willow	89	45	65.9	0.14	
Yerba Buena L. H.				0.12	
Zenia	84	32	59.2	3.49	
Colorado.					
Alford	76	17	46.4	0.61	3.0
Antelope Springs	71	2	38.1	0.77	0.2
Ashcroft	68	9	39.6	0.73	10.5
Blaine	94	25	58.3	0.07	
Boulder	83	29	52.9	3.43	10.5
Boxelder				0.43	1.0
Breckenridge	72	10	40.3	1.23	17.5
Canyon	86	24	52.0	1.14	2.0
Castlerock	84	4	49.4	1.25	5.2
Cedaredge	78	20	50.2	0.17	
Cheesman	82	10	49.2	2.35	8.0
Cheyenne Wells	87	24	53.3	T.	0.0
Clearview	71[g]	10[h]	43.5[h]	0.99	12.0
Collbran	78	20	48.2	0.78	
Colorado Springs	81	20	50.8	1.15	9.0
Durango	78	21	50.8	0.13	
Fort Collins	81	20	49.4	1.48	1.8
Fort Morgan	81	21	50.4	0.06	
Fox	89	24	51.6	0.38	
Fruita	80	20	50.3	0.22	
Garnett	75	4	40.6	0.19	3.0
Gilman				0.84	8.5
Gleneyre	82	22	49.8	1.33	1.0
Glenwood	78	17	49.0	0.72	
Greeley	83[d]	20[d]	50.5[d]	0.51	T.
Grover				0.00	
Gunnison	75	9	41.5	0.13	1.1
Hamps	79	19	48.8	0.53	4.0
Hoehne	87	22	49.8	0.83	5.5
Holly	91	18	55.8	0.52	
Holyoke (near)	86[e]	22[e]	50.9[e]	0.21	
Husted	80	8	46.4	1.75	8.0
Lake Moraine	66	5	38.6	3.09	33.5
Lamar	92	22	55.6	0.76	
Laporte				1.53	T.
Las Animas	88	24	52.6	1.15	
Lay	73	13	42.4	0.70	2.0
Leadville (near)	64	12	39.6	0.28	2.8
Leroy	83	23	51.3	0.29	
Longs Peak	65	4	39.5	2.07	17.5
Mancos	78	14	47.8	0.20	
Marshall Pass				1.18	18.0
Meeker	77	16	44.9	0.92	T.
Montrose				0.02	
Moraine	76	8	44.2	1.83	10.0
Pagoda	75	22	49.1	1.67	
Parachute	78	21	51.0	0.65	
Platte Canon				2.39	3.5
Rangely	77	16	48.2	0.38	
Rockyford	87	22	51.6	1.62	1.0
Rogers Mesa	83	21	51.2	0.18	
Ruby				0.66	9.0

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Colorado—Cont'd.	°	°	°	*Ins.*	*Ins.*
Saguache	73	23	46.8	0.10	1.0
Salida	77	17	47.1	1.02	6.8
San Luis	75	11	45.0	0.00	
Santa Clara	73[h]	18[h]	45.7[h]	2.54	16.0
Silt	77	21	50.6	0.66	
Sugar Loaf	76	14	46.4	2.95	22.0
Trinidad	80	27	53.0	1.04	7.0
Vilas				0.11	
Waterdale	83	24	50.1	1.20	
Westcliffe	77	— 4	43.9	1.63	18.0
Whitepine	61	9	37.4	0.37	3.5
Wray	87	21	52.2	0.34	
Yuma				0.10	
Connecticut.					
Bridgeport	80	28	55.6	5.09	T.
Canton	75	21	50.6	4.10	0.2
Colchester	74	26	52.4	4.12	T.
Falls Village				6.04	1.0
Hartford	73	29	52.8	3.46	T.
Hawleyville	77	26	54.0	6.32	T.
Lake Konomoc				3.34	
New London	75	31	54.2	2.14	T.
North Grosvenor Dale	75	23	50.9	3.11	T.
Norwalk	79	27	52.9	5.07	T.
Southington	75	23	52.8	3.00	0.5
South Manchester				3.18	
Storrs	73	25	51.0	2.79	T.
Voluntown	76[i]	26	57.0[k]	3.70	T.
Wallingford				3.33	
Waterbury	79	25	53.2	4.77	T.
West Cornwall	76	24	51.2	6.39	1.5
West Simsbury				3.70	0.5
Delaware.					
Delaware City				4.58	T.
Milford	86	31	58.8	6.06	
Millsboro	84	31	58.2	6.50	
Newark	79	31	55.8	5.58	T.
Seaford	83	32	57.5	8.44	
District of Columbia.					
Distributing Reservoir*[5]	76	35	58.2	4.00	
Receiving Reservoir*[5]	75	37	57.0	4.43	
West Washington	82	31	57.4	4.89	
Florida.					
Archer	89	35	68.7	0.79	
Avon Park	90	43	72.4	1.42	
Bartow	91	41	73.2	0.97	
Bonifay	91	35	67.6	1.46	
Brooksville	93	38	72.2	0.43	
Carrabelle	84	39	68.1	4.00	
Clermont	86	45	72.7	0.95	
De Funiak Springs	91	34	67.2	2.08	
Deland	88	35	69.8		
Eustis	91	42	71.8	0.43	
Federal Point	87	40	70.2	0.86	
Fernandina	86	45	70.0	1.93	
Fort George*[1]	84	50	71.6		
Fort Meade	91	36	72.0	0.79	
Fort Pierce	90	49	73.9	0.00	
Flamingo	89	53	75.7	2.40	
Gainesville	90	36	70.4	0.70	
Grasmere	86	41	70.6		
Huntington	92	34	71.0	1.03	
Hypoluxo	89	52	75.8	2.78	
Inverness		35		0.85	
Jasper	91	34	68.2	2.06	
Johnstown	88	35	67.2	1.05	
Kissimmee	86	42	71.4	1.02	
Lake City	91	36	68.8	1.57	
Macclenny				1.70	
Madison	90	38	68.8	4.95	
Malabar	91	47	73.8	0.95	
Manatee	91	39	72.6	1.30	
Marco	91	39	73.4	1.74	
Marianna	88	38	65.9	0.85	
Merritt Island	87	50	74.0	0.84	
Miami	89	54	76.6	4.48	
Middleburg	89			2.76	
Molino	97	30	67.2	5.53	
Myers	86	48	72.4	1.62	
New Smyrna	87	42	71.0	1.71	
Nocatee	91	41	72.6	0.34	
Ocala	92	37	71.0	0.36	
Orange City	92	35	71.4	1.13	
Orange Home	91	36	71.6	0.15	
Orlando	91	41[m]	71.1[f]	1.69	
Pinemount	92	34	68.4	2.38	
Plant City		40		0.95	
Rockwell	93	36	71.4	0.70	
St. Andrews	87	33	68.4	5.79	
St. Augustine	88	41	71.2	2.95	
St. Leo	91	33	69.9		
Stephensville	91	35	70.9	0.20	
Sumner	90	29	69.1	0.63	
Switzerland	88	38	68.6	0.41	
Tallahassee	89	37	68.3	2.92	
Tarpon Springs	90	38	71.6	0.34	
Titusville[g]	89	42	70.2	0.96	
Wausau	92	33	67.2	0.91	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Florida—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wewahitchka	92	34	68.6	6.58	
Georgia.					
Abbeville				2.92	
Adairsville[e]	86	29	62.1	2.87	
Albany	95	39	66.4	1.78	
Allapaha	90	35	65.8	1.97	
Americus	87	34	63.7	1.57	
Athens	83	32	60.3	2.05	
Blakely	88	34[e]	65.1	1.34	
Bowersville	89	30	61.8	1.11	
Butler				1.74	
Camak	87	31	62.0	2.26	
Canton				2.38	
Carlton				1.52	
Clayton	80	25	57.2	2.76	
Columbus	92	34	66.4	2.30	
Coney	92	31	64.5	1.29	
Covington	89	30	63.7	1.17	
Dahlonega	84	28	59.0	1.20	
Dawson	92	29	65.4	1.80	
Diamond	91	25	58.6	2.08	
Douglas	93	35	66.8	2.06	
Dublin				2.19	
Dudley	91	32	64.6	1.94	
Elberton	88	30	63.2	1.32	
Experiment	85	30	62.3	1.17	
Fitzgerald	90[c]	33[d]	66.0[d]	2.64	
Fleming	91	34	66.7	3.05	
Forsyth	90	30	64.1	2.45	
Fort Gaines	87	35	65.2	1.06	
Gainesville	81	30	59.4	1.18	
Gillsville	88	28	60.9	1.18	
Greenbush	88	30	61.2	4.85	
Greensboro	90	29	61.8	3.07	
Griffin	90	30	63.4	0.44	
Harrison	88	32	62.6	2.87	
Hawkinsville	90	30	62.9	2.08	
Hephzibah				1.90	
Jesup	93	35	67.3	3.47	
Lost Mountain	87	30	61.4	1.31	
Louisville	87	32	63.0	2.02	
Lumpkin	94	32	66.9	1.79	
Marshallville	87[f]	33[e]	65.6[e]	1.75	
Mauzy	92	32	66.8	2.25	
Milledgeville	88	32	61.8	2.58	
Millen	88	32	63.2	1.52	
Monticello	92	31	63.4	2.04	
Morgan	90[c]	32[d]	64.4[d]	1.06	
Naylor				1.00	
Newnan	88	29	61.4	1.98	
Oakdale				0.88	
Oakfield				0.96	
Point Peter	87	29	61.3	1.43	
Poulan	91	33	65.6	2.01	
Putnam	90	31	65.1	1.92	
Quitman	87	36	65.9	2.90	
Ramsey	88	26	60.0	3.31	
Resaca				2.62	
Rome	91	28	60.2	2.69	
St. Marys	86	38	67.8	3.01	
Statesboro	90	34	65.2	2.50	
Talbotton	90	29	63.8	2.46	
Tallapoosa	91	29	61.1	1.10	
Thomasville	93	36	67.5	2.97	
Toccoa	89	29	61.2	1.45	
Valona	87	35	65.6	1.00	
Vidalia	93	39	66.1	3.67	
Washington	84	31	60.6	3.40	
Waverly	92	33	67.0	1.59	
Waycross	89	38	66.6	3.16	
Waynesboro	85	34	61.8	1.64	
Westpoint	93	27	63.2	1.66	
Idaho.					
Albion	75	15	47.2	1.21	
American Falls	79	13	48.3	0.19	
Blue Lakes	86	24	56.0	0.58	
Burnside	70	16	47.4	1.90	
Cambridge	78[i]	18[i]	47.9[i]	0.77	
Chesterfield				1.18	2.0
Forney	74	12	45.2	1.21	
Garnet	86	31	56.2	0.38	
Grangeville	72	26	49.5	2.37	
Lake	74	14	46.4	0.85	8.5
Lakeview	67	29	47.0	1.96	
Lost River	78	11	45.9	0.53	
Meadows	72	18	45.2	2.02	
Moscow	71	32	50.1	1.65	
Murray	72	23	43.8	2.54	
Oakley	80	21	51.9	0.55	
Ola	74	22	49.4	2.53	
Orofino	73	27	50.4	2.25	
Payette	80	22	52.4	0.92	
Pollock	76	29	51.4	1.17	
Porthill	68	26	44.3	0.71	
Riddle				0.68	
St. Maries	79	26	50.0	1.48	
Soldier	74	12	45.5	0.69	
Vernon	71	14	46.0	0.95	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	*Ins.*	*Ins.*
Weston	76[i]	25[i]	49.6[i]	1.27	
Illinois.					
Albion	87	28	56.3	4.55	
Aledo	81	25	53.8	5.09	
Alexander	89	25	56.2	2.12	
Antioch	82	24	50.8	0.80	
Ashton	81	22	51.9	3.40	T.
Astoria	82	21	53.4	3.15	
Aurora	83	22	51.0	2.69	
Benton	91	28	59.4	2.43	
Bloomington	89	22	56.1	1.48	
Bushnell	85	24	55.8	2.43	
Cambridge	81	28	53.0	2.32	
Carlinville	87	22	56.3	1.50	
Carrollton	86	28	56.8	1.39	
Centralia	89[j]	34[j]	64.0[j]	3.60	
Charleston	87	20	56.1	2.68	
Chester	.....	.....	.....	2.92	
Chicago Heights	.....	.....	.....	1.26	
Cisne	91	24	58.4	2.14	
Coatsburg	84	27	54.6	1.77	
Cobden	90	31	59.4	3.59	
Decatur	88	20	56.4	4.07	
Dixon	84	32	53.9	3.21	
Equality	90	28	58.8	2.17	
Fandon	84[h]	25[h]	57.0[h]	4.42	
Flora	88	23	55.9	1.81	
Friendgrove	88	29	56.4	3.54	
Galva	85	28	53.5	1.88	
Grafton	.....	.....	.....	1.85	
Greenville	90	27	58.8	2.51	
Griggsville	87	29	58.2	2.53	
Halfway	87	32	58.7	3.19	
Havana	87	24	56.5	2.18	
Henry	84	20	53.8	1.35	
Hillsboro	88	25	57.4	1.78	
Hoopeston	84	20	53.7	1.92	
Joliet	84	23	52.3	1.40	T.
Kishwaukee	84	23[e]	51.9	2.77	T.
Knoxville	84	22	52.3	2.20	
Lagrange	84	26	51.8	1.50	
Laharpe	85	28	54.6	4.05	
Lanark	83	16	49.6	2.02	T.
La Salle	87[g]	25[g]	56.4[g]	1.02	
Loami	.....	.....	.....	1.97	
McLeansboro	89	29	57.9	2.96	
Martinsville	87[f]	23[f]	56.0[f]	2.28	
Martinton	88	18	53.6	2.54	
Mascoutah	85	26	57.2	3.45	
Mattoon	80	28	55.2	1.29	
Minonk	84	22	53.3	2.23	
Monmouth	84	22	52.9	2.35	
Morrison	83	20	52.2	3.57	
Morrisonville	84	26	56.5	1.73	
Mount Carmel	.....	.....	.....	3.96	
Mount Pulaski	86	27	56.0	3.67	
Mount Vernon	90	28	57.6	3.20	
New Burnside	87[e]	27[e]	59.1[e]	3.35	
Olney	90	27	57.2	1.99	
Ottawa	85	26	54.8	1.43	
Palestine	88	24	55.4	2.66	
Pana	88	27	57.0	2.24	
Paris	87	26	56.6	2.24	
Peoria *a*	.....	.....	.....	2.48	
Peoria *b*	86	28	55.6	2.13	
Philo	87	19	54.0	2.87	
Pontiac	84	26	55.0	2.76	
Rantoul	87	21	53.5	1.85	
Raum	90	28	59.1	2.83	
Riley	81	25	51.8	1.97	
Robinson	89	24	56.2	2.48	
Rushville	85	28	56.0	1.98	
St. Charles	83	21	52.0	1.39	
St. John	89	26	57.7	2.29	
Scales Mound	76	20	49.3	2.38	
Shobonier	90	25	58.3	3.05	
Streator	85	21	53.8	1.02	
Sullivan	87	22	55.8	2.98	
Sycamore	83	22	51.3	2.57	
Tilden	88	27	57.4	4.32	
Tiskilwa	80	28	52.6	2.43	
Tuscola	88	19	53.8	1.74	
Urbana	88	21	54.2	2.70	
Walnut	83[d]	25[d]	54.0[d]	2.98	
Winchester	87	27	56.6	2.45	
Winnebago	82	25	51.8	4.35	
Yorkville	83	22	50.8	2.40	
Zion	82	20	51.6	1.78	
Indiana.					
Anderson	83	22	54.6	3.19	
Angola	79	25	52.3	1.91	T.
Auburn	.....	.....	.....	2.10	T.
Bloomington	86	28	56.4	2.70	
Bluffton	85	20	54.2	3.42	
Butlerville	87	22	56.4	1.50	
Cambridge City	82	20	52.2	3.39	
Columbus	88	22	54.6	2.91	
Connersville	85	23	53.2	3.85	
Indiana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Crawfordsville	85	19	54.9	2.49	
Delphi	86	20	52.7	1.81	T.
Elkhart	84	28	53.1	1.13	T.
Farmersburg	89	22	55.6	2.62	
Farmland	80	24	53.6	3.67	
Fort Wayne	80	25	54.7	2.45	T.
Franklin *[1]	85	27	54.0	3.65	
Greencastle	82	27	54.4	3.31	
Greensburg	86	21	55.6	2.62	
Hammond	83	28	55.3	2.54	
Hector	82[f]	19[f]	51.5[f]	1.82	
Holland	92	25	58.8	2.26	
Huntington	83	25	51.7	2.80	T.
Jeffersonville	86	27	57.2	1.73	
Kokomo	84	24	54.6	2.20	
Lafayette	86	23	53.4	2.58	
Laporte	81	29	52.0	1.30	T.
Logansport	86	23	53.5	4.85	
Madison *a*	90	25	57.4	1.16	
Madison *b*	.....	.....	.....	1.06	
Marengo	89	23	56.8	1.92	
Marion	79	21	54.0	2.71	T.
Markle	83	21	53.1	3.80	T.
Mauzy	88	19	54.6	3.91	T.
Moores Hill	88	24	58.0	1.21	
Northfield	83	18	52.0	3.48	
Paoli	91	23	56.8	2.36	
Princeton	90	26	56.0	4.53	
Rensselaer	82	23	53.4	2.46	
Richmond	85	18	53.7	2.80	
Rockville	86	27	55.2	2.44	
Rome	95	20	57.8	1.45	
Salem	91	20	57.8	1.88	
Scottsburg	88	26	57.5	1.88	
Seymour	86	26	56.3	2.20	
Shelbyville	86[e]	.....	.....	4.69	
South Bend	83	28	52.6	2.47	T.
Syracuse	84	23	53.2	3.13	T.
Terre Haute	88	28	58.0	3.31	
Topeka	80	25	53.4	0.59	
Valparaiso	83	24	53.6	1.10	
Veedersburg	.....	.....	.....	2.35	
Vevay	85	26	57.0	1.65	
Vincennes	93	25	57.6	3.81	
Washington	91	27	56.8	5.21	
Worthington	90	22	56.1	3.85	
Indian Territory.					
Ardmore	86	28	62.2	2.88	
Chickasha	90	30	60.8	1.93	
Fairland	88	29	59.6	3.63	
Goodwater	89	31	60.8	2.88	
Hartshorne	87	32	61.6	9.05	
Healdton	86	28	61.3	2.52	
Holdenville	87	34	62.6	2.66	
Hugo	87	35	65.0	4.30	
Marlow	93	35	62.6	0.20	
Muskogee	87	32	60.6	3.53	
Okmulgee	89	32	61.0	4.49	
Pauls Valley	86	26	60.8	2.85	
Ravia	84	36	61.4	4.12	
Roff	84	32	60.2	3.64	
South McAlester	87	35	64.6	8.76	
Tahlequah	.....	.....	.....	2.03	
Tulsa	.....	.....	.....	5.17	
Wagoner	88	30	62.6	3.65	
Webbers Falls	88	28	59.9	4.36	
Iowa.					
Afton	82	26	53.2	1.96	
Albia	80	23	52.8	2.26	
Algona	76	26	52.0	1.40	
Allerton	81	28	54.2	2.22	
Alta	79	28	51.6	1.12	
Amana	81	23	51.6	2.15	
Ames	80	23	51.6	1.07	
Atlantic	83	21	52.6	2.12	
Audubon	83	18	51.8	2.72	
Baxter	80	25	51.8	1.23	
Bedford	81	25	53.4	1.78	
Belknap	83	34	57.8	2.32	
Belleplaine	75	22	47.2	1.34	
Bonaparte	85	26	53.3	3.78	
Britt	77	25	50.1	1.76	
Buckingham	.....	.....	.....	1.45	
Burlington	83	29	55.6	2.74	
Carroll	84	26	53.8	1.39	
Cedar Rapids	80	26	52.0	1.48	
Chariton	90	26	53.4	2.10	
Charles City	79	22	49.0	1.84	
Clarinda	88	26	54.8	1.17	
Clearlake	75	26	50.2	3.08	
Clinton	83	21	51.4	1.85	
College Springs	81	31	54.0	2.36	
Columbus Junction	81	26	53.4	3.28	
Corning	80	28	53.2	0.84	
Corydon	81	26	54.0	1.74	
Cumberland	.....	.....	.....	2.15	
Decorah	77	23	50.0	2.13	
Delaware	79	25	49.8	1.69	
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Denison	80[e]	22[e]	51.0[e]	0.89	
Desoto	86	20	54.0	0.55	
Dows	84	25	52.6	1.63	
Earlham	82	16	51.2	0.90	
Elkader	78	20	50.2	1.46	
Estherville	79	24	50.2	2.49	
Fayette	79	18	49.4	1.73	
Forest City	80	27	48.6	1.76	
Fort Dodge	80	31	53.0	2.02	
Fort Madison	.....	.....	.....	2.75	
Galva	79[e]	24	50.8	0.93	
Gilman	.....	.....	.....	1.72	
Glenwood	83	31	54.8	1.25	
Grand Meadow	77	28	50.3	2.11	
Greene	78	23	50.3	1.85	
Greenfield	82	29	53.3	1.52	
Grinnell	73	28	52.2	1.45	
Grinnell (near)	79	28	52.0	1.35	
Grundy Center	80	25	51.6	1.05	
Guthrie Center	83	22	55.8	2.75	
Hampton	80	28	52.5	1.82	
Hanlontown	77	24	49.8	2.17	
Harlan	81	25	52.1	4.50	
Hopeville	81	30	54.3	1.45	
Humboldt	79	24	51.8	2.41	
Independence	80	23	50.6	1.85	
Indianola	81	27	53.6	1.27	
Iowa City	81	21	51.9	3.60	
Iowa Falls	78	21	48.4	1.72	
Jefferson	.....	.....	.....	2.52	
Keosauqua	82	22	52.1	3.42	
Lacona	.....	.....	.....	2.13	
Larchwood	79	28	51.6	2.16	
Larrabee	78	26	51.3	2.05	
Leclaire	.....	.....	.....	3.17	
Lemars	79	25	51.0	.....	
Lenox	81	29	53.2	1.13	
Leon	80	29	53.9	1.27	
Logan	81	23	51.8	1.60	
Maple Valley	.....	.....	.....	1.16	
Maquoketa	81	18	50.2	2.24	
Marshalltown	83	21	51.8	1.61	
Mason City	74	31	51.6	3.25	
Monticello	85	20	50.4	2.20	
Mountayr	83	29	55.0	1.03	
Mount Pleasant	82	23	52.4	2.72	
Mount Vernon	79	25	51.5	1.16	
New Hampton	77	24	49.4	1.48	
Newton	79	26	52.0	1.08	
Northwood	75	26	49.8	2.13	
Odebolt	78	25	51.0	0.79	
Ogden	84	25	51.8	2.00	
Olin	81	21	51.4	1.87	
Onawa	84	30	55.2	1.71	
Osage	75	25	48.8	2.99	
Osceola	84	29	55.0	0.88	
Oskaloosa	80	23	53.0	1.68	
Ottumwa	83	26	55.4	2.49	
Pacific Junction	85	27	53.5	1.69	
Perry	82	25	52.8	2.35	
Plover	78	24	50.8	1.43	
Primghar	77	28	50.6	3.22	
Redoak	80	29	54.4	1.21	
Ridgeway	82	28	53.2	2.02	
Rockwell City	80	27	53.0	1.70	
Ruthven	89[e]	30	53.8	3.30	
Sac City	80	25	53.2	0.82	
St. Charles	83	28	55.6	0.32	
Sheldon[d]	79	27	51.0	3.31	
Sibley	73[e]	27[e]	48.8[e]	3.98	
Sigourney	82	24	52.8	1.13	
Sioux Center	78	27	50.7	3.75	
Stockport	.....	.....	.....	3.47	
Storm Lake	78	20	50.0	1.32	
Stuart	80	18	49.2	1.03	
Thurman	84	25	54.1	2.78	
Tipton	81	28	53.8	1.67	
Toledo	81	20	52.5	1.37	
Villisca	82	25	50.6	1.27	
Vinton *[1]	80	22	51.0	1.67	
Wapello	79	27[e]	53.0	2.05[b]	
Washington	83	25	51.7	2.98	
Washta	.....	.....	.....	1.93	
Waterloo	82	23	51.6	2.05	
Waukee	.....	.....	.....	1.22	
Waverly	79	23	50.8	1.87	
Westbend	79	23	50.8	1.05	
Whitten	80	24	51.0	1.24	
Wilton Junction	82[d]	22[d]	53.0[d]	2.85	
Woodburn	.....	.....	.....	1.53	
Kansas.					
Achilles	92	17	53.1	0.16	
Alton	89	27	56.6	2.53	
Anthony	.....	.....	.....	5.01	
Atchison	84	34	56.7	2.71	
Baker	84	31	55.7	2.05	
Beloit	87	30	56.4	3.35	
Burlington	86	30	57.8	8.02	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kansas—Cont'd.	°	°	°	Ins.	Ins.
Clay Center	85	26	56.0	3.15	
Colby	92	21	53.8	0.43	
Columbus	86	31	58.3	2.69	
Dresden	92	25	56.3	0.24	
Ellinwood	88	30	58.6	2.38	
Emporia	85	32	55.7	5.10	
Englewood	91	28	59.2	2.86	
Eureka Ranch	93	23	56.2	1.82	
Fall River	87	27	57.8	3.29	
Farnsworth	92	21	56.2	0.68	
Forsha	89	32	59.6	4.26	
Fort Leavenworth	85	33	58.0	4.73	
Fort Scott	89	30	58.5	6.93	
Frankfort	86	21	55.2	3.97	
Fredonia	86[c]	30[c]	58.8[c]	5.51	
Garden City	92	24	56.8	0.40	
Gove *[1]	91	30	56.1	0.66	
Grenola	87	28	57.0	5.76	
Hanover	86	30	56.4	3.10	
Harrison	87	23	55.8	3.10	
Hays	90	27	56.2	1.95	
Holton	87	28	55.3	3.26	
Horton	85	33	56.0	2.23	
Hoxie	93	25	55.4	0.37	
Hutchinson	90	26	56.8	3.44	
Independence	87	34	59.7	3.31	
Jetmore	.....	25	.....	1.82	
La Crosse	91	29	56.8	3.42	
Lakin	89	23	56.0	0.62	
Lawrence	84	35	56.6	4.98	
Lebo	85	34	57.3	5.76	
Macksville	89	28	56.1	3.93	
McPherson	86	30	58.4	5.33	
Madison	85	28	57.3	5.56	
Manhattan *b*	86	30	57.3	3.90	T.
Manhattan *c*	87	28	56.4	5.02	
Marion	88	30	57.6	5.75	
Minneapolis	87	27	56.8	2.31	
Moran	89	32	58.8	4.95	
Mounthope	83	35	59.8	5.00	
Ness City	91	26	58.2	1.41	
Newton	86	28	58.8	6.12	
Norton	90	23	55.6	1.29	
Norwich	86	32	59.6	7.79	
Oberlin	.....	.....	.....	0.47	
Olathe	84	33	57.9	4.12	
Osborne	.....	.....	.....	3.11	
Oswego	87	30	59.4	5.18	
Ottawa	86	26	56.1	7.66	
Paola	85[e]	31[e]	58.1[e]	5.73	
Pleasanton	87	29	58.6	4.25	
Pratt	92	30	59.4	7.93	
Republic	89	25	55.9	2.43	
Rome	89	28	59.6	4.76	
Salina	87	27	58.2	2.63	
Sedan	87	30	59.2	5.11	
Toronto	89	25	57.8	6.40	
Ulysses	92[j]	22[d]	58.7[d]	0.59	
Valley Falls	85	30	55.8	2.99	
Viroqua	90	25	55.8	0.30	
Wakeeney	.....	.....	.....	2.87	
Wallace	92	23	54.4	0.28	
Walnut	87	33	58.1	7.51	
Wamego *[1]	83	32	55.2	4.78	
Winfield	88	30	58.0	6.57	
Yates Center	.....	.....	.....	5.66	
Kentucky.					
Alpha	87	28	57.9	4.65	
Anchorage	89	22	56.4	2.16	
Bardstown	92	23	59.0	1.44	
Beattyville	.....	.....	.....	2.78	
Beaver Dam	96	20	57.2	1.68	
Berea	90[h]	22	58.0[d]	2.99	
Blandville	86	30	59.0	2.25	
Bowling Green	94	20	57.0	2.63	
Burnside	88	23	57.2	2.84	
Cadiz	90	24	57.8	0.95	
Calhoun	95	21	57.7	1.49	
Catlettsburg	91	25	59.1	2.88	
Earlington	90	24	58.0	3.52	
Edmonton	91	21	57.9	3.01	
Eubank	85	20	56.1	2.20	
Falmouth	.....	.....	.....	2.20	
Fords Ferry	90	20	58.2	1.69	
Frankfort	86	25	57.0	2.50	
Franklin	86	28	59.1	2.50	
Greensburg	91	21	54.4	3.11	
Highbridge	93	24	58.8	2.01	
Hopkinsville	91	22	58.8	1.74	
Irvington	90	25	57.8	3.44	
Jackson	89	24	58.8	2.95	T.
Leitchfield	89	23	57.0	1.48	
Loretto	89	19	56.8	1.96	
Mayfield	88	27	59.4	1.83	
Maysville	91	22	57.4	2.31	
Middlesboro	88	20	56.1	2.42	
Mount Sterling	88	22	54.6	2.95	T.
Owensboro	90	28	58.6	1.51	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kentucky—Cont'd.	°	°	°	Ins.	Ins.
Owenton	85	28	57.4	1.93	
Paducah *a*	.....	.....	.....	1.92	
Paducah *b*	87	32	61.2	1.90	
Princeton	92[f]	24[f]	57.3[f]	1.56	
Richmond	89	22	60.3	2.95	
St. John	89	22	57.4	1.57	
Scott	86	25	57.6	1.19	
Shelby City	90	21	56.4	2.86	
Shelbyville	90	21	56.6	2.49	
Taylorsville	87	21	55.6	2.01	
Williamsburg	87	22	57.4	2.20	
Williamstown	88	26	58.1	2.24	
Louisiana.					
Abbeville	91	34	67.0	4.68	
Alexandria	94	33	65.6	2.86	
Amite	92	31	66.2	0.60	
Baton Rouge	94	37	68.0	3.40	
Burnside	89	34	66.4	2.03	
Cameron	88	40	69.3	0.49	
Caspiana	92	35	65.4	2.06	
Cheneyville	92	31	63.8	2.05	
Clinton	92	32	64.5	2.93	
Collinston	93	27	63.2	0.48	
Covington	93	33	66.8	0.94	
Donaldsonville	90	41	68.5	1.90	
Emilie	88	35	65.8	1.12	
Farmerville	89	31	61.7	0.39	
Franklin	93	35	67.9	1.10	
Grand Coteau	89	37	65.9	3.77	
Hammond	91	32	66.1	1.67	
Houma	91	32	66.5	1.14	
Lafayette	89	34	65.4	1.86	
Lake Charles	91	40	67.4	2.04	
Lake Providence	88	31	64.9	0.65	
Lakeside	91	40	67.4	1.10	
Lawrence	91	40	70.0	3.90	
Leesville	91	30	63.9	0.99	
Libertyhill	93	31	65.3	0.56	
Logansport	.....	.....	.....	1.61	
Mansfield	91	33	62.8	1.72	
Melville	93	33	66.5	2.84	
Minden	93	32	61.9	0.97	
Monroe	93	35	66.2	0.32	
New Iberia	87[e]	40[e]	67.2[e]	0.80	
Opelousas	91	33	65.1	3.41	
Oxford	95	32	64.0	1.79	
Plain Dealing	91	31	63.1	2.15	
Port Eads	86	54	72.4	3.18	
Rayne	92	35	67.3	2.42	
Reserve	90	32	67.9	0.57	
Robeline	91	30	62.0	2.65	
Ruston	94	30	65.8	T.	
St. Francisville	92	33	64.6	2.00	
Schriever	92	32[c]	65.2	1.87	
Southern University	.....	.....	.....	0.74	
Sugar Experiment Station	90	43	69.2	0.36	
Sugartown	91	36	65.8	0.72	
Venice	89	40	69.6	0.60	
Wallace	94	35	67.7	1.20	
Maine.					
Bar Harbor	70	27	48.5	5.28	1.0
Belfast	71	20	46.0	3.99	T.
Cornish	71	20	48.0	4.21	T.
Danforth	.....	.....	.....	3.62	4.0
Farmington	72	22	47.2	3.08	T.
Fort Fairfield	63[d]	15[d]	42.2[d]	1.90	3.0
Gardiner	74	21	48.8	3.82	
Houlton	68	22	47.0	2.40	5.0
Lewiston	74	26	49.2	3.53	
Mayfield	66	20	44.4	3.12	0.5
Millinocket	76	27	51.2	2.72	1.0
North Bridgton	75	24	49.5	4.04	T.
Orono	71	22	47.1	3.44	1.0
Patten	65	11	41.4	2.58	3.0
Rumford Falls	74	24	47.6	2.69	T.
South Lagrange	77	20	51.0	2.99	0.5
The Forks	.....	.....	.....	1.60	2.0
Vanburen	69	18	42.6	2.57	2.0
Winslow	73	17	48.4	3.31	
Maryland.					
Annapolis	81	33[f]	56.8[e]	5.40	
Bachmans Valley	75	30	53.2	5.36	T.
Boettcherville	88	28	56.7	2.58	
Boonsboro	81	28	56.8	2.87	T.
Cambridge	84	33	58.0	5.97	T.
Charlotte Hall	89	32	57.4	4.89	
Chase	83	30	55.5	3.56	T.
Cheltenham	83	32	56.4	3.79	
Chestertown	81	35	57.2	4.44	T.
Chewsville	81	31	56.4	3.25	T.
Clearspring	79	29	55.2	2.28	T.
Coleman	84	35	58.2	4.19	
Collegepark	82	28	56.6	4.04	
Colora	.....	.....	.....	4.37	
Cumberland	.....	.....	.....	2.62	
Deerpark	84[e]	22[e]	50.0[e]	2.55	T.
Denton	86	32	57.4	5.55	
Easton	84	32	57.7	4.85	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Maryland—Cont'd.	°	°	°	Ins.	Ins.
Fallston	80	28	56.2	4.89	T.
Frederick	82	32	57.5	2.69	T.
Grantsville	84	23	49.9	2.61	
Greatfalls	84	29	56.7	4.07	
Greenspring Furnace	80	26	55.3	2.23	T.
Hancock	83	25	56.4	2.32	
Harney	.....	.....	.....	2.75	
Jewell	82	34	57.8	3.90	
Johns Hopkins Hospital	83	35	59.2	4.18	
Laurel	85	27	56.0	4.35	
Mount St. Marys College	78	33	57.7	2.15	T.
New Market	78	33	56.0	3.48	T.
Oakland	82	20	50.4	2.96	
Pocomoke City	82	39	63.2	9.63	
Princess Anne	80	26	56.6	7.74	
Sharpsburg	79	31	56.8	3.07	
Solomons	82	37	59.2	3.27	
Sudlersville	83	33	58.6	5.36	
Takoma Park	82	30	56.2	4.27	
Van Bibber	80	32	56.4	2.95	T.
Westernport	80	28	53.2	1.58	
Woodstock	77	33	57.0	2.90	T.
Massachusetts.					
Amherst	78	22	51.4	2.72	T.
Bedford	72	25	51.0	4.61	T.
Bluehill (summit)	73	25	51.4	5.46	
Cambridge	76	26	53.0	4.05	
Chestnuthill	77	25	52.9	4.87	T.
Cohasset	.....	.....	.....	3.91	
Concord	75	22	49.9	4.41	T.
Fall River	73	32	54.0	3.88	T.
Fitchburg *a* *[1]	70	28	49.4	4.87	
Fitchburg *b*	73	24	51.0	4.10	T.
Framingham	75	22	52.2	4.42	
Groton	71	22	50.0	4.70	
Hyannis	.....	.....	.....	5.77	0.2
Jefferson	.....	.....	.....	3.83	T.
Lawrence	74	26	51.0	2.93	T.
Leominster	.....	.....	.....	4.30	T.
Lowell *a*	73	26	52.4	4.46	
Lowell *b*	74	24	51.3	.....	
Ludlow Center	71	18	48.2	2.34	
Middleboro	75	19	50.8	5.35	T.
Monson	73	23	51.4	3.15	T.
New Bedford	72	27	53.5	4.15	
Plymouth	.....	.....	.....	6.32	T.
Princeton	.....	.....	.....	4.78	
Provincetown	73	34	55.4	5.47	
Somerset *[1]	80	26	54.4	4.04	0.5
Sterling	.....	.....	.....	4.38	T.
Taunton	74	19	51.0	3.97	T.
Webster	.....	.....	.....	3.40	
Westboro	76	22	52.2	4.67	T.
Weston	74	23	50.4	4.37	
Williamstown	70	26	49.7	4.46	T.
Winchendon	.....	.....	.....	2.86	T.
Worcester	76	28	52.0	3.21	T.
Michigan.					
Adrian	80	20	52.0	0.85	
Agricultural College	78	23	51.0	2.01	
Allegan	82[e]	20[d]	50.3[d]	1.91	
Alma	78	22	50.4	4.20	T.
Ann Arbor	78	23	51.8	1.47	T.
Annpere	70	40	52.0	.....	
Arbela	77	24	52.2	2.95	T.
Baldwin	81	13	49.2	1.17	
Ball Mountain	73	25	51.2	1.93	
Baraga	73	25	49.8	.....	
Battlecreek	80	23	50.5	1.77	T.
Bay City	75	25	51.6	3.90	
Benzonia	79[f]	24[h]	48.2[g]	1.83	T.
Berlin	74	24	50.6	1.39	T.
Big Rapids	78	17	48.1	2.91	
Birmingham	75	24	51.0	1.50	T.
Calumet	67	22	47.5	4.84	T.
Cassopolis	87	26	51.8	1.20	
Charlevoix	77	32	51.2	0.84	T.
Chatham	79	20	46.6	3.54	T.
Cheboygan	78	28	49.2	3.31	T.
Clinton	82	24	52.3	2.06	
Coldwater	.....	.....	.....	1.25	
Detour	75	30	47.8	5.01	T.
Dundee	79	24	52.5	2.60	
Eagle Harbor[j]	68	32	47.2	3.59	T.
East Tawas	77	23	49.6	1.68	T.
Eloise	76	25	52.4	1.65	
Ewen	71	.....	.....	1.44	
Fennville	81	25	51.2	2.20	
Fitchburg	78	20	50.9	2.02	T.
Flint	75	24	51.0	2.77	T.
Frankfort	75	27	50.4	1.49	
Gaylord	75	25	47.6	0.92	0.2
Gladwin	71	21	48.0	1.20	
Grand Haven	79	29	52.0	1.04	T.
Grand Marais	70	30	48.2	2.25	T.
Grape	78[d]	22[d]	53.0[d]	1.80	T.
Hagar	84	29	53.4	2.52	T.
Harbor Beach	75	28	50.6	2.58	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Harrison	......	......	......	2.82	
Harrisville	72	24	48.6	2.27	
Hastings	82	18	50.8	1.55	T.
Hayes	77[c]	29[c]	50.8[c]	3.91	
Highland Station	......	......	......	1.19	
Hillsdale	80	19	50.4	1.55	
Humboldt	70	22	43.6	......	
Ionia[f]	80	20	50.0	......	
Iron Mountain	73	23	46.6	2.85	T.
Iron River	73	16	43.7	3.30	T.
Ironwood	73	23	47.5	1.61	
Ishpeming	70	21	46.3	4.67	T.
Ivan	76	20	46.8	2.44	0.5
Jackson	81	23	52.6	1.43	T.
Jeddo	76	25	51.5	2.10	
Kalamazoo[f]	70	26	49.7	0.58	
Lake City	76	28	49.2	0.10	
Lansing	79	24	50.3	1.99	T.
Lapeer	74	24	51.8	1.67	
Lincoln	......	......	......	......	T.
Ludington	78	24	52.2	0.33	T.
Mackinac Island	69	29	48.0	5.88	T.
Mackinaw	76[c]	30[d]	48.0[d]	4.22	
Mancelona	78	14[c]	48.0	0.82	0.2
Manistee	79	25	50.6	0.23	T.
Manistique	64	26	47.0	3.42	
Marine City	75	26	52.4	2.46	
Menominee	68	25	48.2	1.39	
Midland	71	30	47.8	3.50	T.
Mio	73	21	46.0	1.47	T.
Montague	76	25	49.9	0.50	T.
Muskegon	79	23	52.0	1.47	
Newberry	72	25	46.9	0.96	
Old Mission	74	31	49.5	1.08	
Olivet	77	26	50.8	3.13	T.
Omer	76	28[d]	49.3[c]	3.21	
Onaway	82	24	47.8	1.18	
Ovid	77	24	50.8	2.78	
Owosso	83	24	54.0	0.40	
Petoskey	80[d]	28	48.6	3.12	T.
Port Austin	74	29	50.0	2.03	
Roscommon	75	......	......	1.40	T.
Saginaw (W. S.)	78	24	51.8	3.19	T.
St. Ignace	71	29	49.0	4.41	T.
St. Johns	79	25	51.8	......	
St. Joseph	......	......	......	0.85	
Slocum	......	......	......	......	T.
South Haven	90	29	54.4	1.26	
Thomaston	72	22	46.2	1.58	T.
Thornville	74	28	51.3	1.83	T.
Traverse City	80	28	49.9	1.32	T.
Vassar	......	22	......	2.35	
Wasepi	80	22	51.3	1.53	T.
Webberville	78	21	50.5	1.99	T.
West Branch	75	......	......	1.36	
Wetmore	......	......	......	2.87	
Whitefish Point	77[g]	28	48.8[g]	1.56	T.
Ypsilanti	75	22	49.6	1.70	T.
Minnesota.					
Albert Lea	75	26	48.4	1.45	
Alexandria	67	27	45.7	2.86	
Angus	71	16	43.9	2.14	T.
Ashby	68	26	46.2	1.87	1.5
Beardsley	76	20	48.8	1.83	
Beaulieu	69	24	47.6	1.97	T.
Bemidji	67	22	48.2	3.10	0.5
Bird Island	77	27	49.2	2.56	
Blooming Prairie	75	27	48.6	2.35	
Brainerd	68[c]	23[c]	46.5[c]	4.18	
Caledonia	77	25	48.7	2.36	
Collegeville	70	29	49.2	2.17	
Crookston	67	23	45.4	2.02	
Currie	79	25	50.4	2.50	
Deephaven	......	......	......	4.40	
Detroit	67	19	45.7	4.12	T.
Duluth (sub station)	71	26	46.2	4.12	T.
Faribault	75	23	49.4	2.08	
Farmington	73	29	48.8	3.92	
Fergus Falls	70	25	47.4	3.20	1.3
Floodwood	72	12	44.0	3.92	
Glencoe	77	30	48.8	4.37	
Grand Meadow	78	23	49.0	2.75	
Hallock	70	13	46.8	1.46	
Lake Winnibigoshish	68	26	46.4	2.89	
Leech	70	15	44.0	2.00	T.
Long Prairie	67	17	46.2	3.10	T.
Luverne	75	26	48.4	2.13	
Lynd	81	19	49.7	2.22	
Mapleplain	75	28	47.9	4.02	
Milaca	73	22	45.8	3.47	
Milan	75[c]	18[c]	47.8[c]	2.21	
Minneapolis [1]	70[e]	23	47.3	3.94	
Montevideo	77	23	49.6	2.95	
Morris	72	24	48.0	1.90	
Mount Iron	70	20	44.6	5.16	0.5
New London	75	26	49.6	4.16	
New Richland	75	27	49.6	1.74	
New Ulm	78	29	49.4	4.72	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Minnesota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Park Rapids	67	18	43.4	2.35	
Pine River	70	16	45.2	5.98	T.
Pipestone	72	30	45.1	3.93	
Pleasant Mounds	79[c]	28[c]	50.0[c]	3.67	
Pokegama Falls	69	14	44.8	3.65	
Redwing *a*	......	......	......	1.80	
Redwing *b*	78	29	50.2	2.31	
Reeds	......	......	......	2.54	
Rolling Green	73	27	51.4	2.50	
St. Charles	79	14	48.8	1.52	T.
St. Peter	80	25	51.2	3.97	
Sandy Lake Dam	66	22	45.8	3.80	
Shakopee	75	25	49.2	4.05	
Tower	70	25	47.0	5.00	T.
Two Harbors	72	21	45.1	3.11	
Wabasha	78	26	51.8	1.75	
Warroad	80	26	46.2	......	T.
Winnebago	77	29	51.4	2.65	
Winona	78	30	50.6	1.87	
Wyoming	......	......	......	3.11	
Zumbrota	74	26	47.9	1.95	
Mississippi.					
Aberdeen	92	27	62.2	1.81	
Agricultural College	92	35	64.6	1.26	
Austin	89	26	60.6	0.56	
Batesville	91	25	60.2	1.00	
Bay St. Louis	89	36	68.7	1.70	
Biloxi	89	41	69.2	2.25	
Boggan	92	28	63.8	1.94	
Booneville	89	29	61.8	0.55	
Brookhaven	91	32	64.8	0.80	
Canton	95	27	65.0	0.98	
Columbus	91	30	63.2	0.87	
Corinth	90	27	59.8	1.19	
Crystal Springs	94	33	65.6	0.73	
Duck Hill	97	......	......	0.50	
Edwards	96	29	66.0	0.70	
Fayette	90	30	63.5	0.90	
Fayette (near)	......	......	......	0.61	
Greenville *a*	86	37	63.6	0.50	
Greenville *b*	93	33	64.4	0.53	
Greenwood	95	27	63.0	0.53	
Hattiesburg	95	30	66.2	2.71	
Hazlehurst	95	32	66.2	0.40	
Hernando	96	35	63.6	0.40	
Holly Springs	90	36	62.0	2.04	
Indianola [b]	......	28	60.4	T.	
Jackson	92	......	......	0.64	
Kosciusko	94	29	63.8	1.81	
Lake	89	26	62.5	0.71	
Lake Como	98	32	65.9	2.25	
Leakesville	95	29	67.1	2.09	
Louisville	95	31	65.2	2.27	
McNeill	91	36	68.5	0.33	
Macon	96	31	63.7	1.85	
Magnolia	93	29	65.1	1.12	
Natchez	92	33	66.2	0.65	
Nittayuma	91	28	62.8	0.45	
Okolona	96	29	62.6	0.07	
Patmos	......	......	......	0.07	
Pearlington	89	33	67.3	2.01	
Pittsboro	97	26	63.6	0.52	
Pontotoc	91	28	63.2	0.69	
Port Gibson	95	28	63.2	0.76	
Ripley	90	23	60.2	0.50	
Shoccoe	94	30	62.2	2.30	
Stonington	......	......	......	0.49	
Suffolk	93	30	65.6	0.67	
Swartwout	90	30	67.3	1.68	
Thornton	92	29	63.6	0.91	
Tupelo	95	22	62.6	0.46	
University	94	30	64.4	1.09	
Utica	94	29	65.6	1.11	
Walnutgrove	93[d]	25[d]	65.0[d]	3.38	
Watervalley	95	28	64.4	2.00	
Waynesboro	90	29	63.8	1.00	
Westpoint	88	31	62.4	1.84	
Woodville	89	36	65.6	1.77	
Yazoo City	93	24	63.2	0.55	
Missouri.					
Appleton City	87	29	58.7	3.78	
Arthur	88	27	57.9	3.98	
Avalon	86	29	57.2	2.21	
Bethany	80	25	53.6	2.24	
Birchtree	84	32	57.2[c]	2.72	
Blue Springs	84	28	56.6	2.65	
Boonville	......	......	......	3.13	
Brunswick	86	29	56.4	2.27	
Carrollton	85	28	56.6	2.09	
Conception	83	30	55.8	1.65	
Darksville	85	27	56.4	1.97	
Dean	87	25	58.2	2.15	
Desoto	87	27	58.8	2.20	
Downing	......	......	......	2.58	
Edgehill	86	25	56.0	5.98	
Eightmile*[3]	......	36	56.6	5.82	
Edwards	......	......	......	6.33	
Fairport	......	......	......	1.11	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
Fayette	86	30	59.0	2.56	
Fulton	88	22	57.8	2.67	
Gallatin*[1]	86	32	58.8	1.40	
Gano	......	......	......	4.45	
Glasgow	86	28	57.4	2.53	
Gorin	......	......	......	2.92	
Grant City	82	29	55.1	1.70	
Halfway	86[f]	30[g]	60.2[f]	3.50	
Harrisonville	86	28	56.0	4.16	
Hazlehurst	......	......	......	1.77	
Hermann	......	......	......	2.75	
Houston	84	24	56.2	3.59	
Huntsville	86	28	57.2	2.53	
Ironton	88	23	57.4	6.38	
Jackson	89	27	59.0	3.31	
Jefferson City	89	30	59.2	2.31	
Joplin	85	32	60.8	3.63	
Kidder	84	29	55.7	1.24	
Koshkonong	85	33	58.6	3.11	
Lamar	88	30	59.2	5.97	
Lamonte	......	......	......	3.82	
Lebanon	84	28	58.2	3.64	
Lexington	86	28	58.0	3.12	
Liberty	85	28	56.0	3.07	
Louisiana	87	19	56.6	1.73	
Macon	86[d]	29[d]	56.2[d]	2.04	
Marblehill	90	26	59.2	3.38	
Marshall	85	27	56.8	3.42	
Maryville	83	30	53.4	2.40	
Mexico	87	26	57.6	1.85	
Miami*[5]	86	32	57.2	3.15	
Mineral Springs	86	30	58.8	1.68	
Monroe City	85	25	55.9	1.96	
Montreal	87	23	56.4	4.14	
Mountaingrove	83	28	57.1	4.07	
Mount Vernon	89	25	58.0	3.49	
Neosho	87	27	58.8	3.36	
Nevada	......	......	......	5.90	
New Haven	88	31	60.2	2.18	
New Madrid	......	......	......	2.52	
New Palestine	88	30	58.1	2.74	
Oakfield	89	31	59.6	1.99	
Olden	85	26	57.2	2.22	
Oregon	83	34	55.4	2.60	
Palmyra*[5]	82	30	56.2	1.81	
Pine Hill	......	......	......	3.83	
Princeton	85	28	56.0	1.11	
Protem	88	29	58.8	1.88	
Richmond	......	......	......	1.64	
Rockport	......	......	......	1.89	
Rolla	......	......	......	2.84	
St. Charles	90	29	60.2	1.65	
St. Joseph	......	......	......	2.00	
Sarcoxie	......	......	......	4.76	
Sedalia	84	30	57.2	3.63	
Seymour	82	29	56.9	4.17	
Shelbina	......	......	......	1.50	
Sikeston	88	27	59.0	3.33	
Steffenville	84	26	54.8	2.80	
Sublett	84	24	53.9	2.15	
Trenton	82	30	54.8	1.42	
Unionville	82	32	55.0	1.98	
Vichy	86	25	58.0	2.45	
Warrensburg	84	29	57.6	3.41	
Warrenton	86	28	56.8	2.55	
Willowsprings	85[c]	26[d]	56.8[d]	1.38	
Zeitonia	88	26	57.4	3.99	
Montana.					
Adel	70	13	45.1	0.50	2.0
Anaconda	76	25	48.9	......	
Augusta	80	20	48.8	0.27	2.2
Billings[a]	85	25	49.7	......	
Boulder	74	18	46.2	0.39	
Bozeman	75	22	47.5	0.64	
Butte	70	20	47.2	0.70	T.
Canyon Ferry	79	21	47.4	0.39	
Chinook	81	19	49.0	0.28	
Columbia Falls	70	19	43.1	0.75	T.
Crow Agency	82	24	49.2	0.40	
Culbertson	76	18	45.6	0.12	
Deerlodge	68	21	44.0	......	
Dillon	75	20	48.5	0.23	T.
Ekalaka	75	18	48.6	0.20	2.0
Fort Benton	74	26	47.0	0.28	
Fort Harrison	76	26	47.4	......	
Glasgow	78	13	45.9	0.09	
Glendive	80	20	48.2	T.	
Greatfalls	78	25	51.8	0.45	T.
Hamilton	71	20	45.4	1.00	
Kipp	75	16	46.8	0.43	
Lewistown	81	15	48.6	0.25	3.0
Livingston	80	26	52.8	0.42	
Marysville	69[c]	26	45.6	1.47	T.
Missoula	72	25	48.2	1.19	
Ovando	72	19	43.0	1.35	
Parrot	77[e]	26[e]	50.6[e]	0.06	
Philipsburg	80	22	47.0	0.65	T.
Plains	73	26	46.5	1.17	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Montana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Poplar	77	18	49.0	0.20	
Redlodge	77	21	46.8	0.71	
St. Pauls	78	23	51.4	0.15	T.
St. Peter	70	14	50.2	0.37	3.0
Springbrook	76	20	47.4	0.32	
Toston	79	21	48.2	T.	
Townsend				0.26	
Troy	74	21	44.5	1.15	T.
Twin Bridges	75	15	45.7	0.00	
Utica	81	18	49.4	0.05	0.5
Wolf Creek	74	25	49.6	1.02	1.0
Wolsey	68	11	40.6	0.64	2.3
Yale	74	16	47.6	0.07	
Nebraska.					
Agate	82	12	47.1	0.68	
Agee *[1]	88	24	50.3	1.30	
Albion	90[e]	23[e]	54.4[e]	1.99	
Alliance	80	18	50.0	0.10	
Alma	92	24	55.8	1.83	
Ansley	90	24	52.4	0.83	
Arapahoe				0.30	
Arcadia				0.90	
Ashland *a*	86	31	56.1	1.75	
Ashland *b*				2.34	
Ashton				1.11	
Auburn	85	24	55.2	1.59	
Aurora	88[1]	27	55.8[d]	1.80	
Bartley	93	22	54.3	0.73	
Beatrice	85	28	55.4	3.32	
Beaver	91	27	56.8	0.90	
Bellevue				1.89	
Benedict				2.35	
Benkleman				0.24	
Blair	84	25	54.0	1.34	
Bluehill				2.49	
Bradshaw				3.02	
Bridgeport	83	15	50.0	0.80	
Brokenbow	91	23	53.4	0.98	
Burchard				1.85	
Burwell				1.54	
Callaway	88	19	50.9	1.10	
Central City				1.10	
Chester				2.58	
Columbus	84	31	54.2	0.99	
Crete	85	30	55.4	3.64	
Culbertson	91	22	52.4	0.12	
David City	83	31	54.6	2.17	
Dawson	87	31	56.6	2.81	
Edgar				1.60	
Ericson				2.10	
Ewing				1.45	
Fairbury	90	24	53.7	3.36	
Fairmont	86	30	53.6	2.38	
Fort Robinson	84	25	52.4	0.85	
Franklin	90[d]	21[d]	57.0[d]	2.13	
Fremont	86	25	54.5	2.08	
Fullerton				0.93	
Geneva	89	26	55.4	2.84	
Genoa (near)	85	29	55.1	0.66	
Gordon				0.10	
Gothenburg	92	23	55.5	0.55	
Grand Island *b*	90	26	55.0	1.79	
Greeley				1.15	
Guide Rock				2.50	
Haigler				0.32	
Halsey	90	22	52.7	0.31	
Harvard	85	26	53.4	2.62	
Hastings *[1]	88	31	54.9	1.31	
Hayes Center				0.80	
Hay Spring [1]	82	16	48.8	0.98	
Hebron	87	27	55.2	2.75	
Hickman				3.05	
Holbrook				0.32	
Holdrege				2.10	
Hooper *[1]	84	29	52.0	1.66	
Imperial	85	24	52.4	0.30	T.
Johnstown				0.58	
Kearney	90	28	56.2	1.04	
Kennedy	89	18	53.0	0.48	
Kimball	82	17	49.2	0.25	
Kirkwood	90	22	54.5	1.17	
Leavitt	86	29	55.2	2.72	
Lexington	91	24	53.2	0.88	
Lockridge	87	27	54.3	2.57	
Lodgepole	82	15	51.0[f]	T.	
Lynch	93	22	56.0	1.27	
Lyons				2.08	
McCook				0.25	
McCool Junction				3.15	
Madison	83	29	52.8	2.24	
Madrid	88	24	52.1		
Marquette				1.74	
Mason				1.20	
Minden	90	27	54.6	1.77	
Monroe				1.33	
Nebraska City *c*	84	24	53.4	3.00	
Nemaha				2.17	
Norfolk	88	22	53.4	2.42	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
North Loup	93	21	54.8	1.17	
Oakdale	87	24	52.1	2.08	
Odell				2.07	
O'Neill	90	24	53.6	0.90	
Ord				1.57	
Osceola				1.40	
Palmer				0.80	
Palmyra *[1]	86	30	53.9	2.65	
Pawnee City				2.60	
Plattsmouth *b*		30		1.39	
Purdum	88	22	52.6	0.21	
Ravenna *a*	90	25	54.1	1.87	
Ravenna *b*				1.45	
Redcloud	89	25	55.2	2.67	
Republican				1.20	
Rulo				1.50	
St. Libory				1.38	
St. Paul	91	23	55.6	0.79	
Salem				1.75	
Santee	89	27	54.8	1.68	
Schuyler				1.95	
Seward	87	27	56.9	3.02	
Smithfield				1.03	
Spragg				0.63	
Springview	85	28	53.6	0.52	
Stanton	84[d]	29[d]	53.4[d]	2.55	
Strang				3.27	
Stratton				0.25	
Stromsburg				2.18	
Superior	86	27	54.0	3.87	
Syracuse				1.76	
Tablerock				2.63	
Tecumseh *c*				2.07	
Tekamah	88	25	55.8	1.43	
Turlington	85	30	55.5	1.67	
University Farm	86	25	55.3	2.96	
Wahoo				2.73	
Wakefield	85	25	52.4	3.93	
Wallace				0.30	
Wauneta				0.41	
Weeping Water				1.86	
Westpoint	87	29	54.6	2.09	
Wilber				3.21	
Wilsonville				0.35	
Winnebago	87	22	54.0	2.20	
Wisner				2.72	
Wymore				3.28	
York	87	27	54.8	2.82	
Nevada.					
Austin	74	30	51.2	0.00	
Battle Mountain	87	20	53.0	0.60	
Belmont	71	25	49.4	0.04	
Candelaria	74	34	56.8	0.11	
Carson City	81	22	52.0	0.05	
Cranes Ranch				0.68	
Dyer	82	19	49.0	0.81	
Elko	79	13	48.4	0.05	
Ely	73	19	47.5	0.55	
Eureka	76	20	50.8	T.	T.
Fallon	80	29	52.0	0.56	
Golconda *[1]	83	23	51.0	0.50	
Halleck *[1]	82	22	54.2	T.	
Hawthorne	82	29	54.4	0.20	
Humboldt	77	25	52.4	0.50	
Lee				0.03	
Lewers Ranch	82	27	54.9	0.48	T.
Lovelocks	80	29	52.8	0.00	
Martins	89	21	57.6	T.	
Mill City *[1]	68	35	46.1	0.00	
Morey	79	26	53.1	1.60	4.0
Palisade	87	32	61.6	0.00	
Palmetto	77	20	51.2	0.58	
Potts	72	11	45.6	0.10	
Reno State University	81	27	53.9	0.15	
Silverpeak	85	31	58.0	0.34	
Sodaville	84	30	56.2	0.08	
Tecoma	75	12	47.4	0.00	
Toano *[5]	65	25	45.8	0.34	
Wabuska	90	20	57.9	0.25	
Wadsworth *[1]	78	28	45.9	0.00	
Wells *[1]	56	25	40.8	0.30	
Wood	81	15	49.8	0.28	
New Hampshire.					
Alstead	68	20	48.1	2.45	T.
Bartlett				3.26	0.6
Berlin Mills	70	16	45.7	2.07	2.0
Bethlehem	65	19	45.4	2.83	3.0
Bretton Wood				2.77	
Brookline *[1]	74	18	48.8	3.82	T.
Chatham	73	15	45.7	4.95	T.
Concord	72	20	48.2	3.81	T.
Durham	74	24	50.2	3.74	
Franklin Falls	70	22	47.2	3.38	0.8
Grafton	70	16	46.8	3.27	1.0
Hanover	72	18	47.6	2.20	0.5
Jefferson				2.43	
Keene	72	17	49.0	2.16	T.
Littleton	65	19	46.0	2.99	5.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New Hampshire—Cont'd.	°	°	°	*Ins.*	*Ins.*
Nashua	73	22	50.0	4.56	T.
Newton	73	19	48.8	4.06	T.
North Woodstock				2.53	
Plymouth	70	20	48.0	3.94	T.
Stratford	73	15	46.4	2.30	1.0
New Jersey.					
Asbury Park	77	32	57.5	8.35	
Barnegat	83	28	57.6	10.04	T.
Bayonne	79	32	56.8	11.88	T.
Belvidere	79	28	55.0	8.21	
Bergen Point	78	32	55.8	13.79	T.
Beverly	84	33	57.6	6.90	T.
Blairstown	76	30	53.6	8.27	
Bridgeton	84	31	58.4	6.49	
Canton				7.23	
Cape May C. H	81	33	57.9	5.36	
Charlotteburg	75	26	52.8	14.05	
Chester	75	29	53.2	10.36	T.
College Farm	79	30	55.5	7.16	
Dover	75	28	51.7	10.77	T.
Elizabeth	78	32	55.8	10.25	
Essex Fells	77[f]	29[f]	54.2[f]	12.28	T.
Flemington	78	31	56.0	6.85	
Friesburg	80	31	56.4	6.27	
Hanover	76	28	53.7	10.44	T.
Hightstown	77	32	55.6	7.12	
Imlaystown	79	33	56.8	6.23	
Indian Mills	83	27	57.6	7.89	
Lakewood	78	30	56.8	8.17	
Lambertville	79	30	56.4	7.32	
Layton	76	24	51.8	9.21	
Moorestown	80	31	57.0	8.79	
Newark	77	31	55.5	13.26	T.
New Brunswick	79	32	55.9	7.76	T.
Newton	75	28	52.0	9.99	
Oceanic	78	32	57.0	7.06	T.
Paterson	77	31	56.5	16.19	T.
Pemberton	81	30	56.2	8.61	T.
Perth Amboy	78	33	57.2	11.28	T.
Phillipsburg	78	31	55.2	8.23	
Plainfield	80	29	54.7	8.37	T.
Pleasantville				12.01	
Rancocas				8.61	T.
Ringwood	78	25	52.6	11.36	
Rivervale	77	25	54.4	12.81	
Salem	86	32	58.2	5.93	T.
Sandy Hook	77	37	58.0	4.38	T.
Somerville	81	28	54.7	6.96	T.
South Orange	77	32	54.3	11.46	
Sussex	76	28	53.8	9.19	T.
Toms River	83	29	56.4	4.17	
Trenton	76	36	58.8	6.84	T.
Tuckerton	82	31	56.4	9.41	
Vineland	81	31	57.0	7.40	
Woodbine	83	29	55.7	6.27	
Woodstown				6.09	
New Mexico.					
Alamagordo	88	29	59.1	0.00	
Albert	91[e]	30	58.7	0.33	
Albuquerque	85	24	53.9	0.00	
Alma	84	22	53.0	0.00	
Arabela	85	25	55.6	0.00	
Bellranch				1.13	
Cambray				0.00	
Carlsbad	99	30	66.3	0.00	
Deming				0.00	
Dorsey	83	26	50.6	0.22	
Eagle Rock Ranch	78	22	48.0	1.87	12.0
Engle	84	23	55.6	0.00	
Fort Bayard	81	26	56.0	T.	
Fort Stanton	78	17	48.0	0.48	
Fort Union	87	15	49.8	0.05	0.5
Fort Wingate	78	20	52.2	0.00	
Gage				0.00	
Galisteo	76	32	54.0	0.00	
Gallinas Spring	84	25	52.8	0.00	
Golden				T.	T.
Las Vegas	80	21	50.2	0.00	
Lordsburg				0.00	
Mesilla Park	88	29	57.9	0.00	
Mountainair	79	18	49.1	T.	T.
Raton	87	25	52.7	T.	
Roswell	90	26	57.5	T.	
San Marcial	90	25	56.9	0.00	
Strauss				0.00	
Taos	80	18	51.0	T.	
Winsors	72[g]	12[g]	43.1[g]	0.00	
New York.					
Adams				5.58	2.0
Addison	73	25	51.6	4.42	T.
Akron				1.46	
Alden	74	30	51.7	1.97	0.1
Amsterdam	70	22	50.4	6.89	T.
Appleton	80	32	52.4	3.20	T.
Arcade	74	25	47.8	3.53	T.
Athens	72	28	52.7	7.40	1.0
Atlanta	74	25	49.5	3.86	T.
Auburn	72	28	51.6	6.23	2.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
New York—Cont'd.					
Avon	76	26	50.9	2.20	
Baldwinsville	73	27	52.0	6.33	T.
Beaver	69	18	44.8	3.48	4.2
Bedford	75	29	54.0	6.93	
Berlin	73	21	50.6	4.99	T.
Blue Mountain Lake				8.20	2.0
Bolivar	75	22	49.1	4.11	1.3
Bouckville	68	24	49.0	8.09	6.0
Brockport	79	29	52.4	3.70	T.
Caldwell	70	24	50.0	5.19	T.
Canajoharie	70	24	50.0	6.49	3.0
Canaan Four Corners	70	23	49.9	6.87	T.
Carmel	69	29	50.4	8.45	T.
Carvers Falls	73	19	48.6	4.11	T.
Chazy	72	18	50.0	3.84	0.5
Clockville				9.74	5.0
Cooperstown	69	26	48.8	8.32	5.5
Cortland	70	24	50.4	11.47	T.
Cutchogue	80	31	55.6	4.53	T.
Dekalb Junction	76	18	49.4	5.25	T.
De Ruyter	72	24	49.0	8.14	5.0
Easton				5.52	
Elba	78	28	51.1	2.59	T.
Elmira	76	24	52.9	5.10	T.
Fayetteville	73	28	52.1	7.47	5.0
Franklinville	76	26	48.2	3.69	2.4
Gabriels	70	2	42.6	4.51	1.0
Gansevoort				5.02	
Glens Falls	72	21	49.8	4.66	T.
Gloversville	71	22	49.0	5.75	0.5
Greenwich	67	24	49.5	4.14	T.
Griffin Corners	71	19	47.6	8.38	4.0
Harkness	70	23	49.4	4.51	T.
Haskinville				3.19	0.9
Hemlock	72	29	51.8	2.89	T.
Homer	69	24	49.0	6.84	1.2
Honeymead Brook	73	24	51.4	8.25	T.
Indian Lake	70	9	45.2	5.92	1.4
Ithaca	71	27	50.6	5.69	0.4
Jamestown	78	27	51.4	3.24	0.8
Jeffersonville	75	23	50.2	10.13	3.0
Keene Valley	73	11	47.1	5.00	2.0
King Ferry				6.15	T.
Liberty	71	23	48.6	8.88	T.
Littlefalls, City Res.	66	25	49.9	7.58	2.0
Lockport	78	31	52.1	2.50	T.
Lowville	71	13	47.9	6.48	1.0
Lyndonville				2.16	T.
Lyons	75[e]	30[e]	52.6[e]	4.66	T.
Middletown	77	27	53.1	9.05	T.
Mohonk Lake	69	26	50.4	8.90	T.
Moira	76	18	50.0	4.52	2.0
Newark Valley				5.85	0.5
New Lisbon	68	20	47.2	7.36	1.0
Number Four	65	15	45.2	7.65	1.6
Nunda	78	27	51.7	2.34	T.
Ogdensburg	73	18	50.2	4.74	T.
Old Chatham				4.87	0.8
Oneonta	73	25	50.8	7.97	T.
Oswegatchie	74	16	48.2	7.94	T.
Otto	76	28	50.4	4.29	
Oxford	69	24	49.7	7.06	2.5
Palermo				5.30	3.0
Penn Yan	74	29	52.6	3.96	0.1
Perry City	71	26	49.7	5.79	1.9
Plattsburg Barracks				2.16	T.
Port Jervis	76	27	53.0	10.60	T.
Potsdam	75	18	49.6	6.27	0.7
Primrose	76	29	53.8	11.30	T.
Redhook				7.78	
Richmondville	72	25	49.7	6.78	T.
Ridgeway	78	32	52.2	2.78	T.
Rome	71	28	50.4	7.95	T.
Romulus	74	28	52.0	6.76	1.0
Salisbury Mills				14.63	T.
Saranac Lake	68	11	46.0	4.94	2.0
Saratoga Springs	68	22	50.3	4.16	T.
Scottsville				1.60	T.
Setauket	76	35	55.4	3.66	T.
Shortsville	77	27	51.8	3.37	0.1
Skaneateles				6.77	
Southampton	76	30	55.3	3.42	T.
South Butler	74	29	51.9	5.70	2.0
South Canisteo	72	25	49.9	4.47	0.5
South Kortright	72	20	48.3	8.30	2.0
South Schroon	69	18	47.0	5.17	1.5
Speer Falls	71	24	50.4	4.91	T.
Straits Corners	71[e]	20[e]	49.4[e]	5.97	0.8
Ticonderoga	71	22	51.4	3.28	0.5
Volusia	76	30	50.6	3.46	T.
Walton	73	21	49.2	9.12	1.0
Wappinger Falls	77	26	51.6	11.66	T.
Warwick				11.71	
Watertown	72	18	49.8	5.94	2.0
Waverly	76	23	51.5	5.60	0.5
Wedgwood	69	25	49.6	5.05	0.5
Wells	72	16	48.2	7.42	T.
West Berne	76	20	49.6	7.86	1.0
New York—Cont'd.					
Westfield *b*	78	32	52.5	2.73	
Windham	71	23	49.5	9.70	5.0
Youngstown				2.39	T.
North Carolina.					
Brevard	83	19	54.2	2.50	
Brewers	86	23	58.7	3.65	
Bryson City				2.31	
Chapelhill	88	30	59.8	4.98	
Currituck				7.98	
Edenton	85	33	60.4	5.55	
Fayetteville	88	30	61.2	3.93	
Flatrock	82	20	55.8	2.28	
Goldsboro	85	31	59.2	4.28	
Graham				3.30	
Greensboro	83	31	58.4	2.68	T.
Henderson	83	33	58.8	3.51	T.
Hendersonville	84	23	55.6	1.98	
Henrietta	87	26	60.4	1.10	
Horse Cove	76	25	56.1	3.37	
Jefferson	79	22	53.1	1.86	
Kinston	86	27	57.4	3.28	
Kittyhawk	80	41	63.6	6.82	
Lenoir				3.10	
Littleton	84	29	58.8	4.98	
Louisburg	84	28	58.6	4.90	T.
Lumberton	83	30	58.6	4.25	
Marion	86[e]	29[e]	59.3[e]	2.79	
Mocksville				1.05	
Moncure	88	31	59.2	4.62	
Monroe	89	23	58.4	3.40	
Morganton	85	25	58.0	1.87	
Mountairy	82	25	58.0	0.54	
Murphy				2.96	
Nantahala Park	74	24	50.1	4.19	
Newbern	87	30	61.1	4.54	
Patterson *[1]	79	26	52.9	4.28	
Pinehurst	89	32	61.6	4.28	
Pittsboro	89	31	60.4	3.64	T.
Reidsville				2.24	
Rockingham	86	30	60.7	5.21	
Roxboro	84	28	58.8	3.14	
Salem	82	29	57.9	2.30	
Salisbury	89	30	61.0	1.68	
Saxon	85	22	57.7	1.55	
Selma	88	29	59.4	7.23	
Settle *[5]	86	30	61.0	1.65	
Sloan	88	28	61.8	3.02	
Soapstone Mount	85	25	56.9	3.51	T.
Southern Pines *a*	88	32	61.8	4.11	T.
Southern Pines *b*	87	32	61.3	3.98	
Southport	90	35	64.6	3.46	
Statesville	84	25	59.1	1.08	
Tarboro	91	29	60.8	4.81	
Washington	87	31	62.0	3.98	
Waynesville	83	16	54.3	1.65	
Weldon *a*	88	28	59.0	3.67	
Weldon *b*				4.18	
Whiteville	88	33	62.9	3.81	T.
North Dakota.					
Amenia	75	16	46.4	1.44	0.5
Ashley	74	18	45.9	0.80	0.4
Berlin	77	15	46.4	1.15	1.0
Bottineau				1.58	T.
Buxton	71	16	47.4	2.14	0.4
Churchs Ferry	72	19	44.0	0.09	
Coalharbor	75	31	52.9	0.20	
Cooperstown	71	17	44.0	0.90	
Devils Lake	72	23	44.7	0.51	
Dickinson	75	20	49.6	0.08	
Donnybrook				0.32	
Edgeley	78	21	48.8	0.68	0.8
Elbowoods	79	18	45.8	0.14	
Ellendale	75	24	49.6	0.74	
Fargo	72	11[k]	45.2[f]	2.49	
Forman	74	20	49.4	0.90	
Fort Yates	81	26	50.4	0.56	
Fullerton	75	20	47.4	1.06	2.0
Glenullin	75	23	48.7	0.23	2.0
Grafton	69	19	45.5	2.10	
Hamilton	71	12	45.0	1.45	
Jamestown	81	20	48.5	0.90	T.
La Moure				0.89	
Larimore	77	18	45.3	2.50	
Lisbon	74	17	47.0	1.04	1.0
McKinney	77	17	45.6	T.	T.
Manfred	73	19	46.6	0.56	
Mayville	80	16	48.8	2.13	T.
Medora	75	19	46.1	0.40	
Melville	74[h]	21[h]	48.8[h]	0.30	
Milton	72	21	45.3	1.63	
Minnewaukon	72	20	46.9	0.40	
Minto	70	17	44.8	2.01	
Napoleon	78	19	48.0	0.35	0.5
New England	70[l]	20[k]	47.0[l]		
Oakdale	73	24	50.2	0.40	
Palermo	72	33	52.6	0.15	
Pembina	71	13	44.2	0.95	
Power	72	16	46.2	0.97	
North Dakota—Cont'd.					
Steele	73	19	46.2	0.41	
University	68	20	45.7	1.95	
Wahpeton	72	22	49.0	2.25	
Willow City	74	16	44.2	0.52	
Wishek	75	18	44.2	0.10	
Ohio.					
Akron	79	28	53.6	2.49	T.
Atwater				2.88	
Bangorville	80	21	54.6	2.92	T.
Bellefontaine	82	19	54.0	2.00	T.
Bement				3.03	T.
Bladensburg	84	20	52.3	1.61	
Bowling Green	80	22	53.0	2.54	
Bucyrus	81	20	53.2	2.97	T.
Cadiz	87	25	54.4	2.29	T.
Cambridge	89	21	56.0	2.95	
Camp Dennison	88	19	55.0	1.70	
Canal Dover	82	24	53.0	2.91	
Canton	79	28	52.4	3.13	T.
Cardington	81	16	52.4	2.12	T.
Cedarville				2.33	
Circleville	87	21	55.2	1.80	
Clarington	91	25	56.6	2.79	T.
Clarksville	86	26	56.3	2.20	
Cleveland *a*	80	35	54.0	3.79	T.
Cleveland *b*	78	33	52.8	3.61	T.
Clifton	82	22	55.5	2.27	
Coalton	92	15	54.8	2.73	
Colebrook	78[e]	27[e]	49.6[e]	5.16	4.0
Dayton *a*				1.75	
Dayton *b*	87	21	55.6	2.72	
Defiance	82	21	53.4	3.32	T.
Delaware	82	20	53.4	2.56	T.
Elyria	80	29	52.6	2.42	
Findlay	86	23	54.4	2.92	
Frankfort	85	19	55.1	1.36	
Fremont	81	25	54.6	2.58	T.
Garrettsville	80	25	52.2	3.40	T.
Granville	86	21	54.5	2.44	
Gratiot	84	20	54.6	2.22	
Green	90	22	55.1	3.39	T.
Greenfield	83	24	55.4	1.67	
Greenhill	82	24	51.2	2.85	T.
Greenville	82	23	54.0	2.55	
Hanging Rock	93	24	56.6	3.12	
Hedges	83	21	58.8	3.37	
Hillhouse	79	27	51.2	3.76	T.
Hiram	79	29	52.0	3.82	T.
Hudson	79	27	52.4	2.45	T.
Jacksonboro	80	25	56.0	2.13	
Kenton	81	24	52.4	3.25	T.
Killbuck	85	24	54.0	2.11	T.
Lancaster	88	23	56.3	1.80	
Lima	81	23	53.2	3.78	
McConnelsville	90	21	54.8	2.65	T.
Manara	84	22	53.3	2.86	
Mansfield				2.93	
Marietta	84	26	55.8	2.47	
Marion	82	20	54.3	2.31	
Medina	78	27	53.6	2.95	T.
Milfordton	83	20	53.0	1.97	
Milligan	90	19	54.4	1.98	T.
Millport	82	22	52.3	2.55	T.
Montpelier	85	24	53.1	2.06	
Napoleon	81	24	53.2	1.11	T.
New Alexandria	85	28	54.9	2.40	
New Berlin	80	22	51.3	3.46	T.
New Bremen	83	22	54.0	2.86	T.
New Richmond	90	27	57.8	1.39	
New Waterford	84	26	52.6	3.43	T.
North Lewisburg	83	23	54.5	1.90	
North Royalton	77	26	52.6	3.10	
Norwalk	81	24	53.9	2.81	
Oberlin	79	27	52.8	3.06	T.
Ohio State University	82	20	53.6	1.33	
Orangeville	81	23	52.1	2.82	T.
Ottawa	84	22	53.3	2.91	T.
Pataskala	86	23	54.8	2.27	
Philo	90	24	55.9	2.01	
Plattsburg	82	21	54.2	1.86	
Pomeroy	82	22	53.8	5.47	
Portsmouth *a*				3.07	
Portsmouth *b*	89	22	56.0	3.07	T.
Pulse	81	21	54.8	1.36	
Richwood	81	22	53.2	1.85	T.
Rittman[e]	81	23	53.3	2.60	
Rockyridge	80	23	54.1	3.02	T.
Shenandoah	78	22	52.2	2.77	T.
Sidney	84	22	54.2	3.07	
Somerset	85	24	55.5	2.57	
Springfield				2.91	T.
Strongsville				3.09	
Thurman	92	21	57.7	4.06	T.
Tiffin	78	27	53.3	2.83	T.
Upper Sandusky	87	22	53.4	3.10	T.
Urbana	79	25	52.6	2.15	
Vickery	81	23	53.7	2.71	
Walnut				2.05	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
Ohio—Cont'd.					
Warren	83[e]	26	51.8[b]	1.51	T.
Warsaw	87	16	55.8	2.11	
Wauseon	83	22	52.5	2.50	T.
Waverly	90	19	56.0	2.81	
Waynesville	83	21	54.7	1.62	
Wellington	79	26	53.4	2.27	
Willoughby	.....	.....	.....	3.43	
Wilson	89	15	53.8	2.41	
Wooster	79	26	53.2	2.63	T.
Zanesville	.....	.....	.....	2.22	
Oklahoma.					
Beaver	90	27	58.2	1.44	
Binger	91	25	60.3	5.21	
Chandler	86	33	60.8	2.51	
Cloud Chief	92	31	63.2	0.48	
Eldorado	95	29	63.0	0.30	
Fort Reno	90	35	64.2	1.80	
Fort Sill	94	31	60.4	0.40	
Grand	90	23	58.7	1.00	
Guthrie	87	36	61.2	2.40	
Hennessey	95	32	60.7	3.13	
Hobart	91	32	63.3	1.03	
Jenkins	92	32	61.2	2.74	
Kenton	88	26	56.7	0.82	T.
Kingfisher	93	31	62.3	1.25	
McComb	88	32	61.3	3.57	
Mangum	95	35	64.7	0.25	
Meeker	92	28	60.7	3.77	
Newkirk	88	29	57.3	5.51	
Okeene	.....	.....	.....	0.93	
Pawhuska	86	24	54.8	6.15	
Perry	87	34	60.9	4.28	
Sac and Fox Agency	83	32	61.0	3.10	
Shawnee	89	34	61.8	3.42	
Stillwater	86	33	59.8	3.52	
Taloga	90	26	60.3	1.46	
Temple	93	30	63.4	0.64	
Waukomis	93[d]	36	63.0	5.95	
Weatherford	91	33	61.3	1.50	
Woodward	90	30	58.3	1.15	
Oregon.					
Albany	.....	.....	.....	1.44	
Alpha	78	31	53.8	4.37	
Arlington	74	41	59.4	0.32	
Ashland	85	30	56.2	0.31	
Astoria	73	42	54.8	7.25	
Aurora (near)	76	32	52.0	2.14	
Bay City	84	36	53.8	8.52	
Beulah	85	14	49.4	0.72	
Blackbutte	65	36	49.8	3.20	
Blalock	76[c]	30[c]	56.6[c]	0.31	
Bullrun	.....	.....	.....	5.55	
Burns	84[g]	19[g]	49.6[g]	0.34	
Cascade Locks	73	37	54.6	7.39	
Coquille	.....	.....	.....	1.79	
Corvallis	72	32	52.6	1.73	
Coyote	93	.....	.....	0.30	
Dayville	82	23	51.6	0.56	
Deschutes	83	18	48.2	0.33	
Detroit	.....	.....	.....	2.33	
Doraville	75	34	52.2	3.29	
Drain	82	35	55.2	1.49	
Ella	.....	.....	.....	0.61	
Eugene	74	34	52.6	1.49	
Fairview	89	32	55.2	2.41	
Falls City	67	32	50.8	4.90	
Forestgrove	78	29	53.0	2.95	
Gardiner	87	40	57.8	1.57	
Glenora	74	32	49.6	12.18	
Gold Beach	82	40	57.3	3.19	
Government Camp	76	30	48.5	7.79	
Grants Pass	85	30	56.3	1.19	
Grass Valley	78	20	48.8	0.60	
Hood River (near)	75	30	52.8	3.01	
Huntington	77	23	53.0	0.69	
Jacksonville	85	31	57.2	0.73	
Joseph	72	21	46.2	1.22	
Kerby	83	30	55.9	2.69	
Lagrande	76	22	50.1	1.82	
Lakeview	82	25	50.5	0.44	
Langlois	78	35	55.0	6.58	
Lonerock	80	28	50.8	0.80	
McKenzie Bridge	82	29	52.7	4.13	
McMinnville	78	29	53.6	2.16	
Monroe	74	35	53.3	1.85	
Mount Angel	72	32	52.6	2.43	
Nehalem	.....	.....	.....	9.15	
Newport	77	41	54.8	3.38	
Pine	75	18	48.4	1.40	
Prineville	81	18	49.1	0.32	
Salem	76	33	53.8	1.65	
Sparta	74	27	49.6	2.18	
Stafford	76	35	53.8	2.48	
The Dalles	71	31	52.7	1.10	
Toledo	81	35	52.8	3.52	
Umatilla	76	29	54.0	0.43	
Vale	79	14	48.3	0.46	
Wallowa	74	20	47.3	1.96	
Oregon—Cont'd.					
Wamic	78	25	50.1	0.99	
Warm Spring	79	22	51.4	0.38	
Weston	78	28	50.2	1.19	
Williams	89	26	54.6	0.72	
Pennsylvania.					
Aleppo	89	22	53.8	3.25	
Altoona	77	29	53.0	3.36	T.
Athens	80	28	52.3	5.91	T.
Beaver Dam	.....	.....	.....	2.07	
Bellefonte	77	27	54.6	3.66	T.
Brookville	.....	.....	.....	3.50	
Browers	.....	.....	.....	5.97	
Butler	81	27	53.0	3.48	T.
California	91	26	57.2	2.73	
Cassandra	74	23	49.6	3.00	T.
Centerhall	75	28	51.2	3.75	
Clarion	.....	.....	.....	3.22	
Coatesville	84	31	56.2	6.22	
Coudersport	76	21	49.0	4.30	
Confluence	.....	.....	.....	2.64	
Davis Island Dam	.....	.....	.....	2.90	T.
Derry	87	26	54.0	3.02	
Doylestown	.....	.....	.....	8.15	
Dushore	74	20	49.7	4.98	0.2
East Bloomsburg	.....	.....	.....	4.80	T.
East Mauch Chunk	78	29	53.7	6.26	T.
Easton	76	29	54.2	7.96	
Ellwood Junction	.....	.....	.....	2.58	T.
Emporium	77	27	52.0	4.03	T.
Ephrata	80	30	53.8	3.95	T.
Everett	79	27	52.3	2.90	T.
Forks of Neshaminy	.....	.....	.....	7.73	
Franklin	80	23	52.1	2.77	T.
Freeport	87	27	53.8	3.05	T.
Gettysburg	81	31	56.4	2.86	T.
Girardville	.....	.....	.....	6.75	T.
Gordon	78	24	51.9	5.36	T.
Grampian	81	23	50.2	4.55	T.
Greensboro	.....	.....	.....	3.18	
Greenville	83	25	52.1	4.10	0.5
Hamburg	77	31	54.8	8.42	
Hamlinton	76	26	48.5	8.14	T.
Herrs Island Dam	.....	.....	.....	2.67	T.
Huntingdon *a*	.....	.....	.....	3.57	
Huntingdon *b*	78	23	53.6	3.64	T.
Indiana	84	27	52.8	3.96	0.9
Irwin	89	26	55.3	3.36	T.
Johnstown	86	28	55.0	3.89	1.0
Keating	.....	.....	.....	2.56	T.
Kennett Square	78	30	55.8	6.14	T.
Lansdale	.....	.....	.....	7.53	
Lawrenceville	76	21	50.8	5.10	T.
Lebanon	81	28	55.1	4.44	T.
Leroy	72	27	51.2	5.08	0.5
Lewisburg	78	26	54.0	3.47	T.
Lockhaven *a*	77	26	54.4	3.76	T.
Lockhaven *b*	.....	.....	.....	2.88	
Lock No. 4	.....	.....	.....	2.91	T.
Lycippus	85	29	54.6	2.34	T.
Marion	79	27	54.7	3.17	
Mifflin	.....	.....	.....	2.54	T.
Mifflintown	77	26	54.2	3.65	
Milford	76	25	51.9	10.53	T.
Montrose	72	22	49.4	6.20	T.
New Germantown	78	28	55.4	4.12	T.
Oil City	.....	.....	.....	2.92	
Ottsville	.....	.....	.....	6.80	
Parker	.....	.....	.....	2.48	T.
Philadelphia	79	35	58.1	7.22	T.
Pocono Lake	71	24	47.6	8.03	
Point Pleasant	.....	.....	.....	9.70	
Pottsville	.....	.....	.....	4.85	
Quakertown	78	29	55.2	7.82	T.
Reading	78	31	55.9	4.44	
Renovo *b*	.....	.....	.....	3.60	T.
Saegerstown	80	24	51.1	5.07	T.
St. Marys	75	27	49.6	3.70	
Saltsburg	.....	.....	.....	2.90	0.5
Seisholtzville	.....	.....	.....	8.13	
Selinsgrove	80	27	56.6	3.72	T.
Shawmont	.....	.....	.....	6.25	
Smethport	75	21	49.2	3.11	T.
Smiths Corners	.....	.....	.....	9.18	
Somerset	85	22	50.0	2.99	0.5
South Eaton	75	27	52.1	5.23	T.
Springmount	.....	.....	.....	5.99	
State College	73	29	52.2	3.51	T.
Sunbury	.....	.....	.....	1.44	
Swarthmore	80	30	56.2	5.78	
Towanda	75	23	51.8	4.98	T.
Troutrun	.....	.....	.....	4.65	
Uniontown	90	27	55.5	2.92	T.
Warren	77	23	51.0	3.66	0.6
Wellsboro	71	24	51.6	5.68	T.
Westchester	80	32	56.6	6.06	
West Newton	.....	.....	.....	3.15	
Wilkesbarre	82	25	52.3	4.88	T.
Williamsport	74	28	54.9	4.22	T.
Pennsylvania—Cont'd.					
Windber	.....	.....	.....	4.04	0.9
York	80	32	58.8	3.51	T.
Rhode Island.					
Bristol	70	32	54.4	2.91	T.
Kingston	74	24	52.2	3.05	T.
Pawtucket	76	27	53.6	3.68	T.
Providence *a*	71	32	54.6	2.89	T.
Providence *c*	74	28	53.2	3.09	T.
South Carolina.					
Allendale	87	35	63.6	2.24	
Anderson	93	29	63.8	1.38	
Batesburg	90	29	60.4	2.66	
Beaufort	86	38	66.5	1.98	
Bennettsville	90	31	61.1	3.31	
Blackville	90	30	63.2	2.16	
Bowman	89	30	63.4	3.35	
Calhoun Falls	.....	.....	.....	0.86	
Camden	.....	.....	.....	3.49	
Cheraw *a*	86	30	59.6	3.41	
Cheraw *b*	.....	.....	.....	3.14	
Clarks Hill	90	31	63.7	2.52	
Clemson College	92	25	61.2	1.60	
Conway	85	29	61.5	3.34	
Darlington	91	30	62.8	4.68	
Duewest	87[d]	30[d]	62.1[d]	0.97	
Edisto	.....	.....	.....	2.20	
Effingham	.....	.....	.....	3.80	
Florence	89	30	61.2	4.51	
Gaffney	90	28	61.4	1.50	
Georgetown	87	35	61.0	3.00	
Gillisonville	87	32	63.9	1.84	
Greenville	84	27	57.6	1.39	
Greenwood	86	32	60.8	2.11	
Heath Springs	81	28	58.4	2.61	
Kingstree *a*	85	31	62.2	3.89	
Kingstree *b*	.....	.....	.....	3.90	
Liberty	87	27	60.3	1.66	
Little Mountain	86	31	62.6	2.46	
Longshore	90	29	61.3	2.39	
Lugoff	90	28	59.3	4.29	
St. Georges	86	32	61.8	2.16	
St. Matthews	84	34	62.0	2.95	
St. Stephens	.....	.....	.....	4.03	
Saluda	90	26	61.7	1.71	
Santuck	89	27	59.5	3.02	
Seivern	91[c]	23[c]	60.2[c]	1.75	
Smiths Mills	.....	.....	.....	3.55	
Society Hill	87	32	60.6	3.56	
Spartanburg	88	28	60.5	1.05	
Statesburg	85	35	63.6	3.01	
Summerville	84	32	62.4	3.36	
Trenton	86	32	62.4	2.30	
Trial	85	29	61.6	2.97	
Walhalla	85	28	59.9	2.35	
Walterboro	86	32	63.6	2.78	
Winnsboro	88	34	63.2	2.24	
Winthrop College	86	30	61.0	2.61	
Yemassee	87	34	63.8	2.19	
Yorkville	88	35	63.0	2.68	
South Dakota.					
Aberdeen	.....	.....	.....	1.46	
Academy	84	26	54.4	0.33	
Alexandria	84	23	52.4	1.88	
Armour	88	25	53.4	1.38	
Ashcroft	79	19	49.8	0.33	
Brookings	78	20	48.8	1.85	
Canton	81	24	51.9	1.79	
Centerville	.....	.....	.....	1.43	
Chamberlain	87	24	55.5	0.18	
Cherrycreek	84	19	50.8	0.24	
Clark	77	23	50.8	1.10	
Clear Lake	74	25	49.2	2.37	
Doland	78	20	50.2	1.32	
Elkpoint	92	25	55.6	3.90	
Fairfax	88	29[m]	53.6[f]	0.98	
Farmingdale	.....	.....	.....	0.46	
Faulkton	80	20	50.3	0.41	
Flandreau	80	22	50.0	3.30	
Forestburg	86	20	52.8	1.25	
Fort Meade	79	30	53.7	0.40	
Gannvalley	86	20	52.8	0.38	
Gettysburg	79	23	49.6	0.90	
Grand River School	81	10	46.6	0.68	
Greenwood	90	26	55.5	1.72	
Highmore	.....	.....	.....	0.66	
Hitchcock	86	19	52.8	0.19	
Hotch City	86	19	52.8	0.19	
Howard	.....	.....	.....	3.59	
Howell	82	20	50.0	0.51	
Ipswich	80	21	48.2	0.72	T.
Kidder	73	20	48.7	0.82	1.2
Kimball	81	26	52.7	0.37	
Leola	85	21	49.8	0.87	1.0
Marion	80	25	51.9	3.04	
Mellette	89	20	50.5	0.47	
Menno	84	23	52.5	1.59	
Mitchell	86	23	52.4	1.97	
Oelrichs	89	20	50.6	1.07	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
South Dakota—Cont'd.					
Pedro	85	21	52.6	0.68	
Pine Ridge	83	17	51.0	0.73	
Plankinton	82	21	51.4	0.80	
Ramsey	82	22	50.4	2.01	
Redfield	80	19	49.4	0.83	
Rosebud		24		0.15	
Silver City				0.45	
Sioux Falls	83	24	51.4	2.76	
Sisseton Agency	72	24	49.4	1.51	T.
Spearfish	77	32	51.8	0.39	
Stephan	85	20	50.7	0.17	
Tyndall	89	23	53.2	2.01	
Watertown	73	20	47.4	1.91	
Wentworth	82	24	51.0	1.85	
Wolsey				0.70	
Tennessee.					
Andersonville	89	22	55.8	3.50	
Arlington	90	25	59.0	0.75	
Ashwood	92	23	60.4	0.68	
Benton	92	21	57.4	2.80	
Bluff City				1.37	
Bolivar	92	25	58.8	1.35	
Bristol	84	23	54.5	1.45	
Brownsville	89	26	57.8	1.45	
Byrdstown	85	23	56.8	3.05	
Carthage	94	26	62.1	1.97	
Charleston				3.14	
Clarksville	90	27	59.6	1.[illegible]5	
Clinton				3.[illegible]	
Covington	88	29	60.6	1.42	
Decatur	92	23	59.1	4.10	
Dickson	91	25	58.7	2.29	
Dover	95	23	60.4	1.96	
Dyersburg	94	32	61.3	0.72	
Elizabethton	86	22	55.6	1.68	
Erasmus	88	17	54.2	3.13	
Florence	91	24	59.4	0.91	
Franklin	89	26	59.5	1.73	
Grace *[1]	92	28	61.9	2.50	
Greeneville	84	24	56.4	2.28	
Halls Hill				0.67	
Harriman	86	25	56.6	2.36	
Hohenwald	94	16	57.4	1.92	
Iron City	90	22	58.8	0.76	
Isabella	84	24	55.6	3.60	
Jackson	92	24	59.4	1.64	
Johnsonville	93	21	58.8	1.32	
Jonesboro	84	23	56.4	2.49	
Kenton	93	22	59.4	0.77	
Kingston				2.77	
Lafayette	90	22	57.4	3.12	
Leadvale				1.40	
Lebanon				2.45	
Lewisburg	94	23	60.0	1.53	
Liberty	97	23	60.2	1.28	
Lynnville	90	26	59.6	1.39	
McKenzie	93	34	61.4	0.35	
McMinnville	93	22	59.2	2.14	
Maryville	88	25	58.6	2.78	
Milan	90	26	59.2	1.45	
Newport	84	25	57.1	1.68	
Palmetto	92	26	60.6	1.11	
Pope	94	22	59.4	1.60	
Rogersville	89	24	57.6	1.96	
Rugby	87	16	55.2	2.15	
Savannah	94	25	61.1	0.79	
Sewanee	84	28	58.3	1.15	
Silverlake	75	20	51.1	1.76	
Springdale	87	19	55.8	3.17	
Springville	92	20	59.2	1.10	
Tazewell				2.36	
Tellico Plains	90	22	59.0	3.69	
Trenton	92	22	60.6	1.57	
Tullahoma	91	22	59.0	2.16	
Waynesboro	96	22	60.0	0.92	
Wildersville	87	27	59.6	1.18	
Yukon	91	29	63.0	4.32	
Texas.					
Albany	88	34	63.0	1.26	
Alvin	91	41	69.0	5.61	
Arthur				4.11	
Austin *a*	91	37	66.7	2.75	
Ballinger	86	35	62.2	0.67	
Beaumont				0.67	
Beeville	99	44	71.3	4.64	
Bigspring	92	30	63.4	0.22	
Blanco	88	35	64.1	2.57	
Boerne *[1]	96	39	63.9	1.59	
Bonham	84	35	61.0	4.02	
Booth				2.60	
Bowie	88	36	63.8	1.70	
Brenham	90	40	66.9	3.31	
Brighton	88[e]	41[e]	72.4[e]	1.33	
Brownwood	90	37	65.9	0.10	
Burnet	91	35	65.9	1.98	
Burnside				4.10	
Camp Eagle Pass	93	29	66.6	T.	
Childress	95	38	64.3	1.14	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Texas—Cont'd.					
Coleman	86	40	64.0	1.26	
College Station	93	42	68.6	4.74	
Colorado	93	27	63.2	0.08	
Columbia	89	37	68.2	1.75	
Columbus				3.85	
Comanche	89	33	64.4	0.75	
Corsicana	90	40	66.0	4.40	
Cotulla	100	37	69.8	0.25	
Cuero	92	42	68.4	5.80	
Dallas	88	36	62.9	4.34	
Danevang	94	39	68.4	1.75	
Dialville	87	41	64.6	6.13	
Dublin	84	39	62.8	1.25	
Duval	90	44	67.8	2.27	
Estelle	89	37	63.8	3.47	
Fort Brown	95	50	73.2	0.10	
Fort Clark	88	38	66.7	0.55	
Fort Davis	85	28	59.0	0.33	
Fort McIntosh	95	38	72.5	1.00	
Fort Ringgold	98	40	73.6	0.35	
Fort Stockton				0.00	
Gainesville	82[e]	35[b]	62.2[d]	3.31	
Gatesville	86	43	66.2	2.32	
Georgetown	96	34	66.7	1.13	
Grapevine	87	39	64.2	3.61	
Greenville	88	38	62.8	6.22	
Hallettsville	91	41	68.7	5.12	
Haskell	93	34	64.4	2.84	
Hearne	97	38	71.3	3.63	
Hempstead				2.77	
Henrietta	90	34	64.0	1.29	
Hewitt				3.53	
Hillsboro	88	36	64.1	3.01	
Hondo	90	39	67.2	0.75	
Houston	90	42	67.9	1.93	
Huntsville	88[e]	39[e]	63.8[e]	4.39	
Ira	92	35	64.2	2.54	
Jasper	90	36	67.0	2.06	
Junction				1.71	
Kaufman	88	40	64.8	4.27	
Kent	91	32	60.9	0.10	
Kerrville	85	28	63.4	1.24	
Kopperl				2.07	
Lampasas	90	31	64.8	1.48	
Laureles Ranch				1.81	
Liberty				1.96	
Llano	92	40	64.0	1.20	
Longview	95	36	64.1	3.19	
Luling	92	37	67.0	4.39	
Mann [1]	89	36	62.8		
Menardville	88	27	62.8	1.13	
Mount Blanco	90	31	59.7	T.	
Nacogdoches	87	35	63.0	5.98	
New Braunfels	91	39	67.4	2.20	
Orange				0.11	
Panter				4.18	
Pearsall	93	40	69.8	0.05	
Port Lavaca	89	48	71.1	2.76	
Rhineland	90	30	63.9	0.65	
Rockisland	93	40	68.4	2.55	
Rockland				2.73	
Rockport	82	58	70.1	4.65	
Runge	96[e]	39[e]	69.6[e]	7.32	
Sabinal				0.75	
San Saba	88	30	64.6	0.83	
Santa Gertrudes Ranch				1.66	
Sherman	84	40	63.9	4.17	
Sonora	85	28	63.2	1.41	
Sugarland	93	37	67.8	3.60	
Sulphur Springs	85	38	63.4	5.08	
Temple *a*	89	40	63.8	2.23	
Temple *b*	90	40	63.7	1.96	
Trinity	91	35	66.2	3.89	
Tulia	89	28	57.7	1.92	
Tyler	87	39	63.4	2.19	
Victoria	95	42	70.4	5.45	
Waco	90	40	65.4	2.68	
Waxahachie	96	36	63.6	4.47	
Weatherford	87	35	63.4	4.21	
Wichita Falls				0.55	
Utah.					
Alpine				1.60	
Aneth	85	25	54.8	0.06	
Blackrock	77	13	48.1	0.95	T.
Callao	76	10	49.3	0.18	
Castledale	83	12	48.6	0.78	
Corinne	77	24	50.6	1.63	
Coyoto	77	7	44.8	0.06	
Deseret	82	10	53.5	0.72	
Emery	73	26	48.8	1.03	
Escalante	72	25	50.6	0.41	
Farmington	75	23	48.8	1.44	
Fillmore	81	21	53.6	1.06	
Fort Duchesne	75	15	46.2	0.48	
Frisco	76	26	52.0	0.85	
Garrison	87	16	50.7	0.23	
Giles	78	18	46.9	0.27	
Government Creek	75	20	49.8	0.40	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Utah—Cont'd.					
Green River	97	19	57.9	0.00	
Grover	73	21	49.2	0.52	
Heber	78	12	45.3	0.76	
Henefer	80	11	47.0	0.97	
Hite	91	32	61.6	T.	
Huntsville				2.13	
Ibapah	78	6	46.0	0.31	
Kanab	74	31	56.0	0.80	
Levan	73	20	47.8	1.56	
Loa	73	17	44.6	0.85	
Logan	72	25	50.4	1.01	T.
Lund	73	18	49.9	1.60	
Manti	85	18	49.0	1.21	
Marysvale	79	13	48.9	1.35	0.5
Meadowville	64	18	42.6	0.90	T.
Millville				1.28	
Moab	84	23	53.4	0.28	
Monticello	80	25	53.0	0.00	
Morgan	78[e]	13[e]	46.3[e]	2.72	
Mount Nebo	79	20	52.4	0.38	
Mount Pleasant	78	20	49.0	0.58	
Ogden	74	27	51.0	1.57	
Park City	74	19	46.8	1.10	0.2
Parowan	76	20	48.5	2.03	
Pinto	72[f]	11[f]	43.6[f]	1.75	
Plateau	73	7	44.1	1.28	0.8
Promontory *[1]	73	20	52.6	1.25	
Provo	81	19	50.2	0.55	
Ranch	76	20	49.3	1.09	
Richfield	79[e]	16[e]	48.0[e]	0.83	
St. George	85	23	56.2	1.86	
Salt Air	79	26	51.4	0.84	
Scipio	80	10	48.0	0.67	
Snowville	80	10	46.6	0.34	
Terrace	79	12	49.4	T.	
Thistle	82	28	53.0	1.43	
Tooele	75	28	51.8	0.77	
Tropic	77	27	52.6	0.00	
Vernal	77	20	50.0	0.88	
Vermont.					
Burlington	76	28	51.1	4.55	T.
Cavendish	70	16	47.6	2.94	T.
Chelsea	66	18	44.3	1.97	4.0
Cornwall	73	21	50.5	3.05	0.5
Derby	67	24	45.6	1.96	
Enosburg Falls	73	12	46.5	3.43	T.
Jacksonville	65	21	39.7	2.40	T.
Manchester	69	19	48.8	4.55	T.
Morrisville	70	10	46.4	3.86	5.5
Norwich	68	16	46.6	2.57	T.
St. Johnsbury	70	16	46.6	2.65	1.0
Wells	66	18	47.2	3.82	
Woodstock	69	18	49.4	3.69	T.
Virginia.					
Ashland	81	31	57.4	4.01	
Barboursville	81	30	58.8	2.50	
Bedford	84	35	60.0		
Bigstone Gap	84	21	55.2	1.94	
Blacksburg	80	24	53.2	1.87	
Boykins	89			T.	
Buckingham	88	24	56.6	2.18	
Burkes Garden	76	13	48.8	1.84	
Callaville	80	28	55.9	4.52	
Charlottesville	82	31	59.2	3.44	
Clarksville				1.63	
Columbia	84	17	54.0	3.50	
Dale Enterprise	81	25	54.8	2.00	
Danville				2.04	
Elk Knob	83	27	57.0	2.63	
Farmville	87	22	57.8	3.55	
Fredericksburg	82	28	56.6	4.24	
Hampton	82	34	60.0	7.49	
Hot Springs	75	23	51.4	2.10	
La Crosse	85	28	57.8	4.20	T.
Lexington	81	24	56.0	2.42	
Lincoln	83	28	56.0	3.96	
Manassas	80	30	56.6	4.27	
Marion	83[d]	18[d]	54.2[d]	1.40	
McDowell	77	26	54.2	0.65	
Mendota				2.29	
Newport News	90	43	63.2	6.83	
Petersburg	85	31	58.8	4.45	
Quantico	88	36	61.4		
Radford				0.20	
Riverton				2.00	
Roanoke				2.41	T.
Rockymount	80	24	53.2	2.21	
Saxe	87	22	55.1	2.34	
Shenandoah				1.83	
Speers Ferry				2.04	
Spottsville	89	26	57.2	5.48	T.
Stanardsville	90	25	55.2	2.38	
Staunton	80	29	57.1	2.62	
Stephens City	86	32	56.7	3.09	
Warsaw	82	28	57.4	5.34	
Wilkerson	81	30	58.0	5.54	
Williamsburg	81	30	57.8	4.74	
Woodstock	86	29	57.0	2.78	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wytheville	85	24	55.4	1.64	
Washington.					
Aberdeen	72	38	53.6	5.89	
Anacortes	.....	.....	.....	2.02	
Ashford				6.07	
Blaine	68	30	48.7	3.51	
Bremerton	72	39	55.4	3.03	
Brinnon	68	37	51.7	6.04	
Cedonia	65	25	46.2	0.90	T.
Centralia	73	33	52.8	3.25	
Cheney	.....	.....	.....	0.87	
Clearbrook	72	28	50.4	3.53	
Clearwater	68	36	52.2	10.95	
Cle Elum	78	24	47.2	3.11	
Colfax	78	25	51.4	0.91	
Colville	73	21	45.5	0.95	
Conconully	65	24	45.9	0.95	
Connell				0.17	
Coupeville	69	36	51.6	1.24	
Crescent	70	23	46.6	1.06	
Danville	68	27	45.4	0.88	0.5
Dayton	78	31	53.4	0.99	
East Sound	69[e]	30[e]	49.2[e]	2.29	
Ellensburg	75	20	47.4	0.60	
Grandmound	71	32	53.0	4.00	
Granite Falls	.....	.....	.....	8.13	
Hooper	78	27	52.7	0.36	
Horseheaven				0.40	
Lacenter	74	30	51.4	3.87	
Lakeside	70	26	50.3	0.55	
Lind	79	32	53.8	0.57	
Loomis	70	31	49.3	0.51	
Mottinger Ranch	79	32	55.4	0.32	
Mount Pleasant	75	39	55.4	3.61	
Moxee	77	21	49.6	0.42	
Northport	65	23	42.6	1.24	
Odessa	78	25	52.6	0.43	
Olga	61	29	48.5	2.12	
Olympia	71	34	52.8	4.06	
Pinehill	72	31	50.7	2.22	
Pomeroy	84	31	54.1	0.95	
Port Townsend	67	38	51.5	0.89	
Pullman	73[l]	33[l]	52.0[l]	0.94	
Rattlesnake	71	29	49.2	0.44	
Republic	71	20	44.5	0.50	1.0
Ritzville (near)				0.44	
Rosalia	79	26	49.9	1.05	
Sedro-Woolley	76	33	52.8	3.65	
Silvana	73	30	50.4	1.55	
Snohomish	79	35	52.0	3.83	
Southbend	75	40	55.4	6.01	
South Ellensburg	74	20	47.0	0.12	
Sprague	.....	.....	.....	0.40	
Sunnyside	72	28	51.2	0.40	
Trinidad	73	32	55.0	0.00	
Twisp	75	24	48.6	0.80	
Union	72[h]	35[f]	52.8[g]	6.01	
Usk	65	21	43.6	1.59	0.8
Vancouver	78	34	54.6	2.26	
Vashon	67	38	52.4	3.10	
Waterville	70	24	47.2	0.67	
Wenatchee (near)	74	29	49.6	0.70	
Whatcom	71	31	51.8	1.66	
Wilbur	73	20	46.8	0.77	
Zindel	78	35	56.2	1.26	
West Virginia.					
Bayard	82	21	49.6	2.89	T.
Beverly	78	19	49.6	1.50	T.
Buckhannon	85	19	52.3	2.12	T.
Burlington	81	22	54.3	2.32	
Cairo	90	15	54.1	3.29	
Central	88	19	53.8	3.00	
Charleston	96[e]	20[e]	57.5[e]	3.43	T.
Creston	88	24	55.5	2.93	
Cuba	90	18	54.4	3.12	
Elkhorn	83	23	55.0	1.68	
Fairmont	.....	.....	.....	2.87	
Glenville	88	18	53.6	2.79	T.
Grafton	89	22	54.4	3.42	T.
Green Sulphur Springs	89	17	51.8	1.96	
Harpers Ferry				3.27	
Hinton	84[j]	21[j]	57.4[j]	1.62	
Huntington	90	24	55.0	3.56	
Josiah	90	28	56.0	3.47	
Leonard	78	25	53.4	2.73	
Lewisburg	82	19	52.4	2.21	T.
Lillydale	84	20	56.5	1.82	
Logan	88	21	59.5	1.81	
Lost Creek	88	18	52.7	2.33	T.
Mannington	87	19	53.2	2.20	T.
Marlinton	76	16	49.5	1.52	
Martinsburg	80	31	54.1	2.63	
Morgantown	87	27	56.4	3.21	
Moscow	85	25	55.6	3.10	T.
Moundsville	86	26	56.1	2.17	
New Martinsville	91	25	56.8	2.05	
Nuttallburg	89	20	57.5	2.05	
Oldfields	93	19	53.2	3.31	
West Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Parsons	82	19	50.8	3.04	
Philippi	86	19	52.8	3.00	T.
Pickens	81[g]	19[g]	52.5[g]	2.71	T.
Point Pleasant	88	25	58.2	3.76	
Powellton	92	12	52.1	1.10	
Princeton	82	18	52.6	2.10	
Romney	83	28	56.0	3.23	
Rowlesburg	.....	.....	.....	3.33	
Ryan	90	17	54.2	2.59	
Southside	91	26	56.4	3.29	
Terra Alta	83	22	50.6	4.75	
Travellers Repose[b]	80	17	50.6	1.82	T.
Uppertract	84	21	55.4	1.80	
Valley Fork	87	18	54.2	2.71	T.
Webster Springs	87	20	54.6	0.80	
Wellsburg	83	28	53.3	2.77	
Weston	.....	.....	.....	3.16	
Wheeling *a*	.....	.....	.....	3.77	
Wheeling *b*	90	33	58.3	3.83	
Williamson	90	22	55.7	2.09	
Wisconsin.					
Amherst	81	20	48.9	2.11	
Antigo	76	24	49.5	0.15	
Appleton	.....	.....	.....	2.85	
Appleton Marsh	82	21	48.4	2.73	
Barron	74	22	47.3	3.20	
Beloit	80	26	51.0	3.11	T.
Brodhead	82	20	51.8	1.96	
Burnett	81	22	49.1	1.79	
Butternut	71	18	44.6	3.00	T.
Chilton	80	28	48.4	3.43	
Citypoint	80	20	51.0	1.39	
Darlington	75	15	48.2	2.21	
Delavan	81	24	50.6	3.13	
Dodgeville	78	26	51.2	2.00	
Downing	79	20	46.6	2.45	
Durand	73[g]	27[g]	51.4[g]	2.55	
Easton	78	17	48.0	1.81	
Eau Claire	78	23	49.8	1.99	
Florence	79	21	47.0	2.98	T.
Fond du Lac	80	25	49.6	2.00	
Grand Rapids	78	21	48.7	1.76	
Grand River Locks	.....	.....	.....	3.00	
Grantsburg	72	19	47.4	3.14	
Hancock	77	23	48.2	1.46	
Harvey	81	25	49.8	1.70	
Hayward	71	20	46.0	4.95	
Hillsboro	78	19	48.2	0.82	
Koepenick	75	18	47.0	2.50	
Ladysmith[1]	79	28	50.5	.....	
Lancaster	79	24	50.2	1.67	T.
Madison	78	30	50.4	2.18	
Manitowoc	68	27	49.0	3.41	
Meadow Valley	80	20	50.5	3.08	
Medford	77	22	47.6	4.70	
Menasha	.....	.....	.....	1.56	
Minocqua	73	26	47.8	2.55	
Neillsville	78	20	48.5	1.95	
New London	80	24	47.6	2.18	
North Crandon	72	18	43.2	4.30	
Oconto	77	23	48.4	1.11	
Osceola	75	18	46.8	4.14	
Oshkosh	80	25	49.6	1.19	
Pine River	80	24	49.1	1.67	
Portage	80	25	51.2	1.75	
Port Washington	74	22	47.4	2.83	
Prairie du Chien *a*	80	25	54.1	1.75	
Prairie du Chien *b*	.....	.....	.....	1.34	
Prentice	77	17	45.9	1.61	T.
Racine	82	28	52.8	1.39	
Sheboygan	72	28	49.9	2.80	
Spooner	72	22	47.2	2.32	
Stanley	69	20	48.2	2.96	
Stevens Point	78	21	47.6	1.38	
Valley Junction	72	22	49.5	1.18	
Viroqua	70	25	49.3	1.63	T.
Washburn	71	26	49.6	3.29	
Watertown	80	20	49.4	2.48	
Waukesha	79	26	50.4	2.50	
Waupaca[e]	78	24	48.3	1.86	
Wausau	77	20	46.0	2.18	
Whitehall	77	18	48.0	1.78	.....
Wyoming.					
Afton	74	15	44.2	1.64	1.0
Alcova	72	22	47.5	0.37	
Basin	79	16	48.4	T.	
Bedford	71[e]	12[e]	42.0[e]	2.27	2.0
Border	71[1]	9	41.0[d]	1.29	
Buffalo	78	18	46.6	0.02	T.
Chugwater	79	15	46.4	0.37	2.0
Daniel	69	12	.....	1.46	.....
Evanston	70	12	43.3	0.87	
Fort Laramie	86	13	48.0	0.26	
Fort Washakie	79	18	47.8	1.87	1.5
Fort Yellowstone	70	18	45.2	0.50	T.
Fourbear	72	17	44.6	0.25	2.0
Griggs	78	17	48.4	0.46	
Hyattville	81	20	50.0	.....	.....
Wyoming—Cont'd.	°	°	°	*Ins.*	*Ins.*
Laramie	71	16	43.4	0.50	2.5
Leo	70	11	43.5	0.08	T.
Lolabama Ranch	70	11	42.2	0.61	1.0
Lusk	79	10	46.6	0.00	
Marquette	77	21	49.0	0.38	
Moore	76	22	47.7	0.54	1.0
Moorcroft	78	20	48.1	0.45	
Pinebluff	82	15	48.6	0.56	T.
Phillips	83	20	49.2	0.40	T.
Rawlins	73	18	43.6	0.55	1.3
Redbank	76	23	50.2	0.97	.....
South Pass	72	8	40.6	0.70	4.0
Tensleep	83	18	48.8	0.23	
Thayne	73	11	42.4	1.93	0.7
Thermopolis	74	20	45.6	0.27	0.5
Porto Rico.					
Adjuntas	92	57	74.8	11.08	
Aguadilla	92	65	78.7	13.30	
Aguirre	93	68	80.6	8.25	
Arecibo	90	65	78.2	5.29	
Barros	88	52	74.0	8.64	
Bayamon	95	60	77.6	3.40	
Caguas	92	64	79.0	10.30	
Canovanas	92	70	80.2	5.63	
Coamo	96	60	77.4	3.30	
Carozal	93	60	77.7	9.70	
Fajardo	91	68	81.0	9.87	
Guanica	94	64	79.3	5.85	
Hacienda Josefa	.....	.....	.....	12.50	
Hacienda Perla	85	62	76.6	13.64	
Humacao	91	74	82.4	7.91	
Isabela	92	66	78.1	6.84	
La Carmelita	88	62	75.6	14.20	
La Isolina	91	62	76.6	7.97	
Lares	90	60	75.2	12.40	
Las Marias	94	65	79.7	12.39	
Manati	97	65	79.6	7.17	
Maunabo	93	66	79.9	13.32	
Mayaguez	92	65	79.0	8.36	
Morovis	94	62	78.8	5.85	
Ponce	91	67	79.6	6.42	
Rio Piedras	.....	.....	.....	5.72	
San Lorenzo	91	63	77.4	5.68	
San Salvador	88	61	75.5	6.85	
Santa Isabel	92	66	79.7	6.88	
Utuado	91	62	76.8	6.12	
Vieques	92	67	79.3	8.80	
Yauco	89	67	79.2	5.86	
Mexico.					
Ciudad P. Diaz	80	49	60.6	T.	
Coatzacoalcos	.....	59	.....	23.26	
Durango	75	52	66.8	1.49	
Leon de Aldamas	81	42	63.1	2.48	
Vera Cruz	86	67	76.5	2.80	
New Brunswick.					
St. John	61	28	45.8	3.55	0.5
Isthmus of Panama.					
Alhajuela	95	73	82.6	15.51	
Bohio	.....	.....	.....	13.54	
Colon	.....	.....	.....	10.04	
Gamboa	.....	.....	.....	14.17	
La Boca	86	71	78.5	4.88	
West Indies.					
Columbia, Isle of Pines	92	62	74.4	1.60	

Late reports for September, 1903.

Stations.	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Alaska.					
Coal harbor	59	34	48.1	5.29	
Copper Center	75	8	43.3	1.34	
Kenai	62	20	45.6	2.72	
Tyoonok	68	28	49.3	2.76	
Arizona.					
Gila Bend	114	63	87.0	1.01	
California.					
Ballast Point L. H	.....	.....	.....	0.00	
Cape Mendocino L. H	.....	.....	.....	0.00	
Crescent City L. H	.....	.....	.....	1.01	
East Brother L. H	.....	.....	.....	0.00	
Humboldt L. H	.....	.....	.....	0.04	
Kernville	.....	.....	.....	0.00	
Lime Point L. H	.....	.....	.....	0.00	
Mare Island L. H	.....	.....	.....	0.00	
New Castle	104	44	71.6	0.00	
Piedras Blancas L. H	.....	.....	.....	0.00	
Pigeon Point L. H	.....	.....	.....	0.00	
Point Ano Nuevo L. H	.....	.....	.....	0.00	
Point Arena L. H	.....	.....	.....	0.00	
Point Bonita L. H	.....	.....	.....	0.00	
Point Conception L. H	.....	.....	.....	0.00	
Point Fermin L. H	.....	.....	.....	0.10	
Point George L. H	.....	.....	.....	0.28	
Point Hueneme L. H	.....	.....	.....	0.00	
Point Loma L. H	.....	.....	.....	0.00	
Point Montara L. H	.....	.....	.....	0.00	
Point Pinos L. H	.....	.....	.....	0.05	

TABLE II.—*Climatological record of voluntary and other cooperating observers. Late reports for September*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Point Sur L. H.	......	......	......	0.00	
Roe Island L. H.	......	......	......	0.00	
San Luis L. H	......	......	......	0.00	
San Miguel Island	74	54	61.6	0.00	
Santa Barbara L. H	......	......	......	0.00	
Santa Cruz L. H	......	......	......	0.00	
Southeast Farallone L. H.	......	......	......	T.	
Trinidad L. H.	......	......	......	0.38	
Yerba Buena L. H.	......	......	......	0.00	
Colorado.					
Moraine	80	19	50.1	2.40	
Idaho.					
Roosevelt	78[1]	19[1]	44.4[1]	1.81	12.5
Indiana.					
Mount Vernon	99	39	70.3	0.74	
Kansas.					
Beloit	91	33	65.9	1.75	
Phillipsburg	......	......	......	0.00	
Missouri.	°	°	°	*Ins.*	*Ins.*
Mineral Spring	90	35	67.1	1.70	
Montana.					
Fort Harrison	83	29	53.6	......	
New Jersey.					
Hanover	84	33	62.6	3.97	
New Mexico.					
Gallinas Spring	92	35	65.2	0.29	
North Carolina.					
Brewers	93	36	67.6	2.62	
Ohio.					
Oberlin	89	36	63.7	1.27	
South Carolina.					
Allendale	96	55	74.8	6.19	
South Dakota.					
Grand River School	83	26	53.4	1.87	
Porto Rico.					
San Lorenzo	92	60	78.3	6.76	

EXPLANATION OF SIGNS.

*Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance "n" denotes 14 days missing.

CORRECTIONS.

September, 1903, Arizona, Tonto, make mean temperature 76.4 instead of 77.6[b].

September, 1903, Iowa, Audubon, make total precipitation 2.79 instead of 2.92.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of October, 1903.*

Stations.	Component direction from— N.	S.	E.	W.	Resultant. Direction from—	Duration.
	Hours.	Hours.	Hours.	Hours.	°	Hours.
New England.						
Eastport, Me	18	18	11	26	w.	15
Portland, Me	18	21	10	25	s. 79 w.	15
Concord, N. H. †	11	7	8	11	n. 37 w.	5
Northfield, Vt	18	36	7	11	s. 13 w.	18
Boston, Mass	19	16	12	23	n. 75 w.	11
Nantucket, Mass	21	16	17	20	n. 31 w.	6
Block Island, R. I	22	17	15	18	n. 31 w.	6
Narragansett, R. I.*	13	8	8	10	n. 22 w.	5
New Haven, Conn	32	13	15	18	n. 9 w.	19
Middle Atlantic States.						
Albany, N. Y	21	24	9	20	s. 75 w.	11
Binghamton, N. Y.†	14	5	10	8	n. 13 e.	9
New York, N. Y	20	16	14	26	n. 72 w.	13
Harrisburg, Pa	27	15	11	20	n. 37 w.	15
Philadelphia, Pa	24	15	14	20	n. 34 w.	11
Scranton, Pa	27	17	17	18	n. 6 w.	10
Atlantic City, N. J	21	14	12	28	n. 66 w.	18
Cape May, N. J	23	18	12	23	n. 66 w.	12
Baltimore, Md	25	14	11	25	n. 52 w.	18
Washington, D. C	22	23	9	21	s. 85 w.	12
Cape Henry, Va.†	14	12	4	7	n. 56 w.	4
Lynchburg, Va	23	19	12	23	n. 70 w.	12
Norfolk, Va	24	23	9	15	n. 80 w.	6
Richmond, Va	23	22	5	26	n. 87 w.	21
Wytheville, Va	21	11	9	36	n. 70 w.	29
South Atlantic States.						
Asheville, N. C	21	20	16	23	n. 82 w.	7
Charlotte, N. C	22	23	18	11	s. 82 e.	7
Hatteras, N. C	20	10	17	15	n. 11 e.	10
Kittyhawk, N. C.*	.....	.....	.....	.....	.....	.....
Raleigh, N. C	26	15	15	18	n. 15 w.	11
Wilmington, N. C	26	13	16	22	n. 25 w.	14
Charleston, S. C	25	11	24	11	n. 43 e.	19
Columbia, S. C	19	15	26	18	n. 63 e.	9
Augusta, Ga	30	14	14	22	n. 27 w.	18
Savannah, Ga	24	11	27	12	n. 49 e.	20
Jacksonville, Fla	34	5	25	11	n. 26 e.	32
Florida Peninsula.						
Jupiter, Fla	32	8	25	17	n. 18 e.	25
Key West, Fla	34	3	41	4	n. 50 e.	48
Sand Key, Fla. †	17	2	22	0	n. 56 e.	27
Tampa, Fla	44	2	20	12	n. 11 e.	43
Eastern Gulf States.						
Atlanta, Ga	20	16	22	15	n. 60 e.	8
Macon, Ga.†	21	2	6	4	n. 6 e.	19
Pensacola, Fla.†	20	3	13	0	n. 38 e.	22
Birmingham, Ala	12	9	13	5	n. 69 e.	8
Mobile, Ala	32	16	13	11	n. 7 e.	16
Montgomery, Ala	25	10	29	6	n. 57 e.	28
Meridian, Miss.†	14	5	12	5	n. 38 e.	11
Vicksburg, Miss	31	13	19	11	n. 24 e.	20
New Orleans, La	30	12	27	8	n. 47 e.	26
Western Gulf States.						
Shreveport, La	26	16	19	15	n. 22 e.	11
Fort Smith, Ark	16	11	30	15	n. 72 e.	16
Little Rock, Ark	24	19	14	19	n. 45 w.	7
Corpus Christi, Tex	22	17	31	5	n. 79 e.	26
Fort Worth, Tex	11	27	22	13	s. 29 e.	18
Galveston, Tex	23	24	26	2	s. 88 e.	24
Palestine, Tex	24	21	24	9	n. 79 e.	15
San Antonio, Tex	21	16	34	6	n. 80 e.	28
Taylor, Tex. †	13	9	5	6	n. 14 w.	4
Ohio Valley and Tennessee.						
Chattanooga, Tenn	24	15	15	18	n. 18 w.	10
Knoxville, Tenn	30	17	14	15	n. 4 w.	13
Memphis, Tenn	29	18	14	13	n. 5 e.	11
Nashville, Tenn	24	16	16	20	n. 27 w.	9
Lexington, Ky. †	8	15	9	7	s. 16 e.	7
Louisville, Ky	23	25	11	15	s. 63 w.	4
Evansville, Ind.†	11	10	11	7	n. 76 e.	4
Indianapolis, Ind	18	28	12	18	s. 31 w.	12
Cincinnati, Ohio	19	22	19	20	s. 18 w.	3
Columbus, Ohio	20	27	8	19	s. 58 w.	13
Pittsburg, Pa	32	16	3	23	n. 39 w.	26
Parkersburg, W. Va	17	31	11	17	s. 23 w.	15
Elkins, W. Va	27	13	7	25	n. 52 w.	23
Lower Lake Region.						
Buffalo, N. Y	15	20	9	31	s. 77 w.	23
Oswego, N. Y	19	28	11	18	s. 38 w.	11
Rochester, N. Y	14	25	8	30	s. 64 w.	25
Syracuse, N. Y	16	26	6	26	s. 63 w.	22
Erie, Pa	17	27	7	21	s. 54 w.	17
Cleveland, Ohio	17	28	13	18	s. 24 w.	12
Sandusky, Ohio †	8	14	3	14	s. 61 w.	12
Toledo, Ohio	13	22	10	30	s. 66 w.	22
Detroit, Mich	16	20	6	33	s. 84 w.	27
Upper Lake Region.						
Alpena, Mich	18	18	12	30	w.	18
Escanaba, Mich	15	24	10	28	s. 63 w.	20
Grand Rapids, Mich	15	26	11	18	s. 32 w.	13
Houghton, Mich.†	7	7	8	14	w.	6
Marquette, Mich	15	20	5	34	s. 80 w.	29
Port Huron, Mich	21	19	8	31	n. 85 w.	23
Sault Ste. Marie, Mich	17	16	15	29	n. 86 w.	14
Chicago, Ill	15	17	15	25	s. 79 w.	10
Milwaukee, Wis	18	15	11	30	n. 81 w.	19
Green Bay, Wis	8	30	11	30	s. 41 w.	29
Duluth, Minn	20	17	8	33	n. 83 w.	25
North Dakota.						
Moorhead, Minn	20	26	19	15	s. 34 e.	7
Bismarck, N. Dak	28	16	15	19	n. 23 w.	13
North Dakota—Continued.						
Williston, N. Dak	13	22	12	29	s. 62 w.	19
Upper Mississippi Valley.						
Minneapolis, Minn.*	3	12	9	12	s. 18 w.	10
St. Paul, Minn	16	26	20	21	s. 6 w.	10
La Crosse, Wis. †	7	14	3	11	s. 49 w.	11
Davenport, Iowa	11	18	21	27	s. 41 w.	9
Des Moines, Iowa	16	22	16	20	s. 34 w.	7
Dubuque, Iowa	16	25	14	23	s. 45 w.	13
Keokuk, Iowa	15	25	21	20	s. 6 e.	10
Cairo, Ill	26	21	17	15	n. 22 e.	5
Springfield, Ill	16	22	16	20	s. 34 w.	7
Hannibal, Mo. †	8	11	9	11	s. 34 w.	4
St. Louis, Mo	13	26	23	14	s. 35 e.	16
Missouri Valley.						
Columbia, Mo. *	7	13	10	8	s. 18 e.	6
Kansas City, Mo	17	22	24	15	s. 61 e.	10
Springfield, Mo	12	32	19	15	s. 11 e.	20
Topeka, Kans.*	7	13	11	5	s. 45 e.	8
Lincoln, Nebr	23	25	12	12	s.	2
Omaha, Nebr	23	26	13	13	s.	3
Valentine, Nebr	25	19	9	22	n. 65 w.	14
Sioux City, Iowa †	12	11	11	6	n. 79 e.	5
Pierre, S. Dak	20	9	23	18	n. 24 e.	12
Huron, S. Dak	24	22	19	15	n. 63 e.	4
Yankton, S. Dak. †	8	9	8	14	s. 80 w.	6
Northern Slope.						
Havre, Mont	13	18	10	37	s. 80 w.	28
Miles City, Mont	13	30	14	16	s. 7 w.	17
Helena, Mont	2	30	1	47	s. 59 w.	54
Kalispell, Mont	7	21	11	35	s. 60 w.	28
Rapid City, S. Dak	18	10	5	40	n. 47 w.	36
Cheyenne, Wyo	29	10	5	30	n. 53 w.	31
Lander, Wyo	8	27	18	23	s. 15 w.	20
North Platte, Nebr	15	18	14	27	s. 77 w.	13
Middle Slope.						
Denver, Colo	18	29	15	12	s. 15 e.	11
Pueblo, Colo	26	10	23	19	n. 14 e.	16
Concordia, Kans	19	28	17	11	s. 34 e.	11
Dodge, Kans	24	16	22	15	n. 41 e.	11
Wichita, Kans	20	25	25	6	s. 75 e.	20
Oklahoma, Okla	12	29	22	12	s. 30 e.	20
Southern Slope.						
Abilene, Tex	13	33	27	5	s. 48 e.	30
Amarillo, Tex	18	26	15	20	s. 32 w.	9
Southern Plateau.						
El Paso, Tex	16	5	32	21	n. 45 e.	16
Santa Fe, N. Mex	14	25	27	13	s. 52 e.	18
Flagstaff, Ariz	22	8	29	15	n. 45 e.	20
Phoenix, Ariz	13	8	30	21	n. 61 e.	10
Yuma, Ariz	27	7	24	16	n. 22 e.	22
Independence, Cal	10	21	18	28	s. 42 w.	15
Middle Plateau.						
Carson City, Nev	13	19	18	22	s. 34 w.	7
Winnemucca, Nev	28	13	20	21	n. 4 w.	15
Modena, Utah	9	11	19	32	s. 81 w.	13
Salt Lake City, Utah	13	17	23	19	s. 45 e.	6
Grand Junction, Colo	17	16	17	30	n. 86 w.	13
Northern Plateau.						
Baker City, Oreg	14	32	19	17	s. 6 e.	18
Boise, Idaho	14	19	18	24	s. 50 w.	8
Lewiston, Idaho †	2	7	13	14	s. 11 w.	5
Pocatello, Idaho	1	24	25	22	s. 7 e.	23
Spokane, Wash	16	18	26	15	s. 80 e.	11
Walla Walla, Wash	4	41	18	12	s. 9 e.	38
North Pacific Coast Region.						
North Head, Wash	18	26	18	15	s. 21 e.	8
Port Crescent, Wash. *	0	7	13	15	s. 16 w.	7
Seattle, Wash	23	20	23	11	n. 76 e.	12
Tacoma, Wash	28	21	6	18	n. 60 w.	14
Tatoosh Island, Wash	5	25	27	14	s. 33 e.	26
Portland, Oreg	20	26	13	20	s. 49 w.	9
Roseburg, Oreg	24	12	14	28	n. 49 w.	18
Middle Pacific Coast Region.						
Eureka, Cal	20	21	13	21	s. 83 w.	8
Mount Tamalpais, Cal	27	11	13	24	n. 34 w.	19
Red Bluff, Cal	35	15	16	8	n. 22 e.	22
Sacramento, Cal	17	27	23	12	s. 48 e.	15
San Francisco, Cal	5	9	3	52	s. 85 w.	49
Point Reyes Light, Cal. *	18	5	0	17	n. 52 w.	22
Southeast Farallon, Cal	33	11	2	33	n. 55 w.	38
South Pacific Coast Region.						
Fresno, Cal	21	12	10	34	n. 69 w.	26
Los Angeles, Cal	18	7	14	33	n. 60 w.	22
San Diego, Cal	33	9	11	23	n. 27 w.	27
San Luis Obispo, Cal	27	18	0	18	n. 63 w.	20
West Indies.						
Basseterre, St. Kitts, W. I	14	10	43	4	n. 84 e.	39
Bridgetown, Barbados	4	22	48	0	s. 69 e.	51
Cienfuegos, Cuba	47	3	30	2	n. 33 e.	52
Colon, Colombia, S. A. †	2	25	3	2	s. 2 e.	23
Curaçoa, W. I	2	10	55	0	s. 82 e.	57
Grand Turk, W. I. †	4	12	19	2	s. 65 e.	19
Hamilton, Bermuda	21	17	19	20	n. 14 w.	4
Havana, Cuba †	5	1	23	2	n. 79 e.	21
Kingston, Jamaica	23	1	3	11	n. 20 w.	23
Port of Spain, Trinidad †	1	15	21	2	s. 54 e.	24
Puerto Principe, Cuba	29	9	34	5	n. 55 e.	35
Roseau, Dominica, W. I. †	.....	.....	.....	.....	.....	.....
San Juan, Porto Rico	1	38	33	8	s. 34 e.	45
Santiago de Cuba, Cuba	33	14	15	5	n. 28 e.	22
Santo Domingo, Santo Domingo	45	9	11	4	n. 11 e.	37

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE IV.—*Thunderstorms and auroras, October, 1903.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	52	T.							4	1							1	3	1														2	12	6	T.
		A.																																0	0	A.
Arizona	56	T.	1	3																														4	2	T.
		A.																															1	1	1	A.
Arkansas	57	T.	3		1	8			1					2	4	1															3	6	7	36	10	T.
		A.																																0	0	A.
California	167	T.	3																															3	1	T.
		A.																															1	1	1	A.
Colorado	81	T.	4	2	1								3			1	1												3		6	6	2	29	10	T.
		A.																														1	2	3	2	A.
Connecticut	21	T.																	6						2									8	2	T.
		A.													2																1		2	5	3	A.
Delaware	5	T.		1				1																										2	2	T.
		A.																																0	0	A.
Dist. of Columbia	4	T.																																0	0	T.
		A.											1																					1	1	A.
Florida	47	T.	1			1	1		1							1		2	5	2						1								15	9	T.
		A.																																0	0	A.
Georgia	55	T.							1	2							1		1						1	3	1							10	7	T.
		A.																															1	1	1	A.
Idaho	34	T.	2			1		1			2	1																		2				9	6	T.
		A.																															6	6	1	A.
Illinois	92	T.	10	7	21	11		13	23							16	7																	108	8	T.
		A.	1																	1				1				1					1	5	5	A.
Indiana	58	T.	7	6	1	19	1	2	21			1	1			12	9		1	1			1			1								84	15	T.
		A.												1																				1	1	A.
Indian Territory	11	T.	1	1		1	1							1																		2	4	11	7	T.
		A.																																0	0	A.
Iowa	149	T.	1	18	25			43	7		1		1	1		10	5	1		1						1		1	1	1		1		119	17	T.
		A.																																0	0	A.
Kansas	77	T.	11	6	4	5	1	20	8		1		2	3	4	4														2	1	23	16	111	16	T.
		A.																																0	0	A.
Kentucky	41	T.	2	1		6	1	2	7	1																	1							21	8	T.
		A.																																0	0	A.
Louisiana	46	T.					1		3						1		1	3	1															10	6	T.
		A.																																0	0	A.
Maine	19	T.																	5					1				3						9	3	T.
		A.													6			1									1						11	19	4	A.
Maryland	48	T.		3						6							5		2															16	4	T.
		A.												1																				1	1	A.
Massachusetts	48	T.																2	13						6									21	3	T.
		A.													5													1				1	11	18	4	A.
Michigan	106	T.	16	3	16	14	1	1	16	1				1	2	1	13															1	1	87	14	T.
		A.										1	1	4	1	1				1						1			1			1	4	16	10	A.
Minnesota	67	T.		13	22	2	1	22	1				1																					62	7	T.
		A.												2																		2	4	8	3	A.
Mississippi	44	T.						1	1						4	2	2	4	1			1									1	1	6	24	11	T.
		A.																																0	0	A.
Missouri	95	T.	11	5	20	19	32	3	28	1					14	11	2														1	19	12	178	14	T.
		A.																																0	0	A.
Montana	40	T.	2	1		1		1				2																						7	5	T.
		A.												1	4	1																2	15	23	5	A.
Nebraska	142	T.		12	13		2	17				1	11	8	1	1																2	1	69	11	T.
		A.																															2	2	1	A.
Nevada	40	T.	4																															4	1	T.
		A.																																0	0	A.
New Hampshire	19	T.																	1									1						2	2	T.
		A.													5																		3	8	2	A.
New Jersey	51	T.		6		1	1			2	13	1		1																				25	7	T.
		A.												1	1																		7	9	3	A.
New Mexico	31	T.															1											1						2	2	T.
		A.																																0	0	A.
New York	99	T.	4	2	1	11	7	1	1	5	1						3	15	12	1				3	7		1	1	1					77	18	T.
		A.											2	4	2	1		1						1								1	1	14	8	A.
North Carolina	56	T.								4		1					3	1	1						6	1								17	7	T.
		A.																																0	0	A.
North Dakota	48	T.		4			1	1	1			1	2																					10	6	T.
		A.												4	7				2									2			1	7	17	40	7	A.
Ohio	128	T.	15	6	1	35	6	8	29	5							27	2							4									138	11	T.
		A.												14	2																		5	21	3	A.
Oklahoma	23	T.	4		1	7		1					4	6	1																	4	11	39	9	T.
		A.																																0	0	A.
Oregon	74	T.				1	1	1			1																							4	4	T.
		A.																															4	4	1	A.
Pennsylvania	91	T.	1			6	5			8			1				9	6	1					1	3									41	10	T.
		A.																																0	0	A.
Rhode Island	7	T.																	5															5	1	T.
		A.																															2	2	1	A.
South Carolina	46	T.		1			1	1		1	1						1	1							6	5								18	9	T.
		A.																																0	0	A.
South Dakota	56	T.		11	12		4	9		2			10	1				3																52	8	T.
		A.																									1						4	5	2	A.
Tennessee	56	T.	4			1	5	6	9	2						1		2																30	8	T.
		A.																															2	2	1	A.
Texas	95	T.	1	1	1	9	6	1				1		11	3		16	6				1								5	1	4	27	94	16	T.
		A.																																0	0	A.
Utah	47	T.	8	8								1																						17	3	T.
		A.																															6	6	1	A.
Vermont	16	T.																																0	0	T.
		A.													3																	1	3	7	3	A.
Virginia	50	T.		6			4	1	1	3	1	1																						17	7	T.
		A.												1																			1	2	2	A.
Washington	64	T.				1		1												1										1				4	4	T.
		A.												1																		1	5	7	3	A.
West Virginia	43	T.		3	1	5	3	2	2			1					4	1																22	9	T.
		A.												1																				1	1	A.
Wisconsin	60	T.	3	6	32	2	16	3	10								5															2		79	9	T.
		A.												6	7			1						1								2	11	28	6	A.
Wyoming	31	T.		5	3																													8	2	T.
		A.																															7	7	1	A.
Sums	2893	T.	119	141	176	167	102	163	175	44	21	12	36	35	34	61	116	52	56	6	0	2	1	5	35	12	3	7	5	11	13	71	89	1770		T.
		A.	1									1	3	42	45	3		3	2	2				3		1	2	4	1		2	19	139	273		A.

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during October, 1903, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y	8-9			4.75														0.38			
Alpena, Mich	1	11:32 a. m.	1:56 p. m.	1.79	11:32 a. m.	12:25 p. m.	0.00	0.11	0.31	0.50	0.68	0.84	0.96	1.01	1.15	1.33	1.47	1.54			
Amarillo, Tex	6	2:00 a. m.	3:45 a. m.	1.30	2:27 a. m.	3:14 a. m.	0.11	0.27	0.36	0.50	0.70	0.82	0.93	0.94	1.02	1.17					
Asheville, N. C	7-8			0.71														0.36			
Atlanta, Ga	8			0.30														0.14			
Atlantic City, N. J	2	4:53 p. m.	6:10 p. m.	0.58	4:56 p. m.	5:15 p. m.	T.	0.09	0.28	0.51	0.55	0.57									
Do	8-9	4:29 p. m.	7:15 a. m.	4.11	7:10 p. m.	8:35 p. m.	0.55	0.17	0.31	0.40	0.51	0.63	0.71	0.74	0.79	0.93	1.04	1.18	1.45	1.67	1.75
					12:40 p. m.	1:30 p. m.	1.24	0.05	0.09	0.13	0.19	0.29	0.38	0.45	0.58	0.63	0.69				
					1:30 p. m.	2:20 p. m.		0.74	0.81	0.87	0.94	1.00	1.09	1.25	1.38	1.46	1.51				
Do	9	8:01 a. m.	7:40 p. m.	5.63	2:20 p. m.	3:10 p. m.		1.54	1.57	1.61	1.66	1.69	1.75	1.81	1.87	1.94	2.00				
					3:10 p. m.	4:00 p. m.		2.15	2.23	2.31	2.35	2.44	2.50	2.55	2.60	2.67	2.72				
					4:00 p. m.	5:15 p. m.		2.77	2.81	2.85	2.90	2.96	3.01	3.07	3.14	3.22	3.35	3.64	3.96	4.06	
Augusta, Ga	16-17			1.62														0.32			
Baltimore, Md	8			1.13														0.56			
Binghamton, N. Y	8	7:54 a. m.	4:20 p. m.	1.16	8:25 a. m.	8:50 a. m.	0.04	0.14	0.30	0.38	0.44	0.50	0.53	0.56							
Birmingham, Ala	7	9:40 p. m.	11:55 p. m.	1.34	10:05 p. m.	10:50 p. m.	0.03	0.18	0.37	0.66	0.96	1.02	1.05	1.13	1.20	1.25					
Bismarck, N. Dak	11			0.13														0.05			
Block Island, R. I	11-12			0.83														0.26			
Boise, Idaho	4			0.26														0.24			
Boston, Mass	17-18	1:05 p. m.	6:50 a. m.	2.58	2:58 p. m.	3:18 p. m.	0.09	0.23	0.41	0.43	0.48										
Buffalo, N. Y	7-8			1.17														*			
Cairo, Ill	1			0.39						0.37											
Charleston, S. C	17	2:05 p. m.	6:34 p. m.	1.11	4:36 p. m.	5:03 p. m.	0.43	0.09	0.23	0.29	0.38	0.50	0.54								
Charlotte, N. C	23-24			0.97														0.45			
Chattanooga, Tenn	7	7:20 p. m.	11:05 p. m.	1.40	7:48 p. m.	8:09 p. m.	0.03	0.26	0.44	0.54	0.76	0.81									
Chicago, Ill	3			0.40											0.40						
Cincinnati, Ohio	7			0.71														0.55			
Cleveland, Ohio	7	12:05 p. m.	6:30 p. m.	1.28	12:22 p. m.	12:55 p. m.	0.01	0.09	0.16	0.26	0.38	0.50	0.57	0.64	0.66	0.71					
Columbia, Mo	6-7	10:30 p. m.	D. N.	2.06	10:34 p. m.	11:30 p. m.	0.02	0.11	0.19	0.34	0.38	0.50	0.68	0.79	0.85	0.91	0.95	1.04			
Columbia, S. C	17			1.41														0.32			
Columbus, Ohio	7	4:50 p. m.	10:20 p. m.	1.18	5:34 p. m.	5:55 p. m.	0.06	0.29	0.49	0.52	0.59	0.63	0.65								
Concord, N. H	17-18			0.77														0.19			
Corpus Christi, Tex	15-16			0.62														0.40			
Davenport, Iowa	6-7			1.50														0.70			
Denver, Colo	29-30			0.86														*			
Des Moines, Iowa	2			0.34														0.34			
Detroit, Mich	7			1.20														0.37			
Dodge, Kans	30			0.20														0.15			
Dubuque, Iowa	3	4:05 p. m.	4:40 p. m.	0.58	4:18 p. m.	4:40 p. m.	0.03	0.21	0.38	0.48	0.53	0.55									
Duluth, Minn	6	12:45 p. m.	11:30 p. m.	1.52	6:50 p. m.	7:50 p. m.	0.52	0.05	0.11	0.18	0.23	0.27	0.34	0.41	0.47	0.57	0.73	0.87			
Eastport, Me	23			0.41														0.28			
Elkins, W. Va	8			1.00														0.32			
Erie, Pa	7-8	8:45 p. m.	D. N.	1.44	9:05 p. m.	9:40 p. m.	0.02	0.17	0.36	0.46	0.52	0.59	0.65	0.71	0.75	0.78					
Escanaba, Mich	3			0.78														0.31			
Evansville, Ind	7	10:30 a. m.	5:20 p. m.	0.98	12 noon	1:00 p. m.	0.09	0.06†	0.12†	0.18†	0.27	0.34	0.49	0.52	0.61	0.62	0.66	0.77			
Fort Smith, Ark	4			0.46														0.44			
Fort Worth, Tex	4-5	3:30 p. m.	7:50 a. m.	2.80	6:56 p. m.	7:31 p. m.	0.02	0.06	0.10	0.18	0.33	0.46	0.61	0.68							
Do	31	3:40 a. m.	7:45 a. m.	0.99	3:55 a. m.	4:25 a. m.	0.03	0.13	0.24	0.35	0.41	0.48	0.54	0.58	0.60						
Galveston, Tex	15	4:25 p. m.	6:30 p. m.	1.23	4:34 p. m.	4:49 p. m.	T.	0.52	0.86	1.02											
Grand Junction, Colo	29			0.03																	
Grand Rapids, Mich	1			0.92														0.63			
Green Bay, Wis	3			0.27														0.26			
Harrisburg, Pa	8			0.99														0.38			
Hatteras, N. C	17	12:45 p. m.	4:15 p. m.	0.87	3:17 p. m.	3:52 p. m.	0.04	0.05	0.11	0.29	0.56	0.69	0.75	0.81							
Huron, S. Dak	12-13			0.16														0.07			
Indianapolis, Ind	7			1.28														0.73			
Jacksonville, Fla	6	12:32 p. m.	2:24 p. m.	1.44	12:32 p. m.	1:23 p. m.	0.00	0.21	0.23	0.34	0.45	0.57	0.75	0.96	1.03	1.15	1.26	1.33			
Do	17	2:15 p. m.	5:00 p. m.	0.85	2:56 p. m.	3:14 p. m.	0.01	0.35	0.67	0.71	0.82										
Jupiter, Fla	19-20			0.92														0.69			
Kalispell, Mont	5-6			0.38														0.22			
Kansas City, Mo	6			0.82														0.57			
Key West, Fla	29-30	10:00 p. m.	5:45 p. m.	2.09	2:27 p. m.	3:28 p. m.	1.04	0.10	0.13	0.16	0.20	0.43	0.50	0.53	0.54	0.56	0.60	0.88			
Knoxville, Tenn	7-8			0.92														0.52			
La Crosse, Wis	6			0.90														0.50			
Lewiston, Idaho	9-10			0.37														0.10			
Lexington, Ky	*																				
Lincoln, Nebr	14			0.80														0.19			
Little Rock, Ark	4			1.49														0.36			
Los Angeles, Cal	1			T.																	
Louisville, Ky	7	1:30 p. m.	8:10 p. m.	0.77	3:00 p. m.	3:14 p. m.	0.06	0.29	0.40	0.47	0.49	0.51	0.55	0.60	0.64						
Lynchburg, Va	8			1.10														0.64			
Macon, Ga	16-17			1.95														0.53			
Memphis, Tenn	7			0.20					0.20												
Meridian, Miss	7-8			0.34														0.32			
Milwaukee, Wis	6-7	8:58 p. m.	12:30 a. m.	1.27	11:10 p. m.	11:55 p. m.	0.24	0.25	0.36	0.40	0.50	0.63	0.76	0.83	0.93	0.97	0.99				
Montgomery, Ala	8			0.69														0.56			
Nantucket, Mass	17-18			2.00														0.73			
Nashville, Tenn	7	3:10 p. m.	4:40 p. m.	0.56	4:18 p. m.	4:28 p. m.	T.	0.31	0.52	0.54											
New Haven, Conn	8-9			1.09														0.33			
New Orleans, La	1			0.21														0.20			
					7:00 p. m.	8:40 p. m.	1.10	0.03	0.12	0.25	0.39	0.43	0.49	0.59	0.67	0.74	0.79	0.93	1.11	1.24	
					2:15 a. m.	2:45 a. m.	3.75	0.10	0.17	0.33	0.43	0.50	0.56	0.60	0.64	0.68	0.72	0.78			
New York, N. Y	8-9	9:17 a. m.	3:55 p. m.	10.04	7:25 a. m.	8:15 a. m.	6.03	0.08	0.15	0.20	0.25	0.31	0.36	0.41	0.48	0.58	0.67				
					8:15 a. m.	9:05 a. m.		0.78	0.89	0.99	1.07	1.16	1.25	1.40	1.62	1.78	1.98				
					9:05 a. m.	9:45 a. m.		2.12	2.25	2.32	2.38	2.44	2.59	2.66	2.77	2.80	2.82				
Norfolk, Va	8-9			1.68														0.60			
Northfield, Vt	5			0.47														0.23			
North Head, Wash																					
Oklahoma, Okla	31			0.60														0.36			
Omaha, Nebr	6			0.31														0.25			
Palestine, Tex	4-5			2.17														0.67			
Parkersburg, W. Va	7-8			0.99														0.49			
Pensacola, Fla	16	5:15 a. m.	10:52 a. m.	3.82	6:02 a. m.	6:30 a. m.	0.09	0.30	0.66	0.84	1.02	1.16	1.20	1.22							
					9:16 a. m.	10:02 a. m.	2.12	0.12	0.23	0.38	0.48	0.53	0.76	0.88	1.12	1.35	1.37	1.38	1.67		
Philadelphia, Pa	8-10			2.87														0.39			
Pittsburg, Pa	7-8			1.05														0.47			
Pocatello, Idaho	6			0.10														0.05			
Portland, Me	12			0.97														0.40			
Portland, Oreg	3			0.52														0.20			
Pueblo, Colo	30			0.86														0.18			
Raleigh, N. C	16-17			2.02														0.44			

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Richmond, Va	8			1.39														0.63			
Rochester, N. Y.	18			0.45														0.43			
Sacramento, Cal.	9			0.12														0.12			
St. Louis, Mo	7			0.98														0.30			
St. Paul, Minn	3	1:52 a. m.	4:10 a. m.	1.99	2:10 a. m.	3:20 a. m.	0.09	0.45	0.54	0.85	1.07	1.12	1.15	1.19	1.24	1.32	1.35	1.51	1.83		
Salt Lake City, Utah	2			0.56														0.18			
San Antonio, Tex	31			0.59														0.59			
San Diego, Cal	2			0.04														0.02			
Sandusky, Ohio	7	4:25 p. m.	9:22 p. m.	1.25	4:45 p. m.	5:10 p. m.	0.08	0.12	0.25	0.41	0.54	0.64	0.67								
San Francisco, Cal	10			0.15														0.06			
Savannah, Ga	16–17	1:16 p. m.	6:20 p. m.	2.06	‡2:18 p. m.	‡2:48 p. m.	0.85	0.23	0.36	0.50	0.69	0.77	0.89								
Scranton, Pa	8-10			5.44														0.35			
Seattle, Wash	27			0.14														0.11			
Shreveport, La	4–5			1.53														0.41			
Spokane, Wash	4			0.47														0.09			
Springfield, Ill	3			0.69													0.23				
Syracuse, N. Y	8	6:3(a. m.	2:20 p. m.	1.57	7:15 a. m.	7:45 a. m.	0.10	0.10	0.21	0.35	0.46	0.54	0.62								
Tampa, Fla	17			0.52														0.30			
Taylor, Tex.	31	7:25 a. m.	10:10 a. m.	1.03	7:35 a. m.	8:10 a. m.	T.	0.11	0.36	0.53	0.63	0.73	0.80	0.92	0.95						
Toledo, Ohio	7			1.17														0.60			
Topeka, Kans	6	5:52 p. m.	9:10 p. m.	1.15	6:22 p. m.	6:35 p. m.	0.08	0.22	0.53	0.70	0.76										
Valentine, Nebr	3			0.20														0.10			
Vicksburg, Miss	31	6:50 p. m.	8:15 p. m.	0.51	7:02 p. m.	7:11 p. m.	0.02	0.27	0.38	0.44											
Washington, D. C	8			1.24														0.55			
Wichita, Kans	30	6:35 a. m.	6:15 p. m.	1.98	8:30 a. m.	9:12 a. m.	0.12	0.29	0.51	0.70	0.80	0.94	1.05	1.13							
Wilmington, N. C.	8			0.61														0.45			
Wytheville, Va	8			0.82														0.64			
Yankton, S. Dak	3			0.21														0.21			
Basseterre, W. I.	16	10:28 a. m.	5:15 p. m.	1.81	12:45 p. m.	1:45 p. m.	0.15	0.21	0.45	0.59	0.76	0.80	0.86	0.94	0.99	1.07	1.17	1.41	1.55		
Bridgetown, Barbados	18			0.56					0.41												
Cienfuegos, Cuba	13	1:40 p. m.	2:40 p. m.	0.61	1:51 p. m.	2:15 p. m.	T.	0.21	0.29	0.36	0.47	0.55	0.58	0.60							
Havana, Cuba	13	4:25 p. m.	7:10 p. m.	1.01	5:20 p. m.	5:52 p. m.	0.03	0.15	0.29	0.40	0.51	0.69	0.86	0.90							
Do	21	9:21 a. m.	11:50 a. m.	1.20	10:25 a. m.	10:40 a. m.	0.12	0.25	0.42	0.51	0.52	0.52	0.54	0.60	0.61	0.68	0.69	0.86	1.07		
Puerto Principe, Cuba	20	2:30 p. m.	6:00 p. m.	1.82	2:32 p. m.	3:42 p. m.	T.	0.11	0.18	0.35	0.58	0.73	0.82	0.87	0.90	0.94	1.01	1.25	1.63		
San Juan, Porto Rico	26	10:45 a. m.	1:00 p. m.	1.39	10:50 a. m.	11:58 a. m.	0.02	0.21	0.29	0.37	0.46	0.49	0.57	0.66	0.71	0.72	0.72	1.03	1.31		
Santiago de Cuba, Cuba.	4	3:10 p. m.	10:00 p. m.	1.26	3:56 p. m.	4:18 p. m.	0.10	0.14	0.25	0.50	0.79	0.87									
Santo Domingo, S. D.	19	12:33 p. m.	1:25 p. m.	0.77	12:42 p. m.	12:55 p. m.	T.	0.13	0.43	0.63	0.68										

* Self register not working. † Estimated. ‡ October 17.

TABLE VI.—*Data furnished by the Canadian Meteorological Service, October, 1903.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Temperature. Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Precipitation. Total.	Departure from normal.	Depth of snow.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
St. Johns, N. F	29.71	29.85	−.06	42.9	− 2.5	48.4	37.3	5.43	+0.08	
Sydney, C. B. I.	29.95	29.99	+.03	46.5	0.0	53.4	39.6	5.75	+1.06	
Halifax, N. S.	29.89	30.00	.00	49.2	+ 2.0	57.1	41.4	6.38	+0.83	T.
Grand Manan, N. B	29.92	29.97	−.03	48.5	+ 1.6	54.0	42.9	4.85	+0.14	2.0
Yarmouth, N. S	29.94	30.01	−.01	48.5	+ 0.9	55.7	41.2	5.77	+1.07	0.3
Charlottetown, P. E. I	29.94	29.98	+.02	46.0	− 0.5	52.8	39.1	3.66	−1.24	T.
Chatham, N. B	29.94	29.96	.00	44.1	+ 1.1	53.4	34.7	3.45	−0.41	0.4
Father Point, Que.	29.94	29.96	+.01	41.5	+ 1.7	48.6	34.4	1.92	−0.98	0.5
Quebec, Que.	29.66	29.99	−.01	44.4	+ 2.0	50.9	37.8	2.23	−0.92	1.5
Montreal, Que.	29.79	30.00	−.01	48.9	+ 4.1	55.9	41.9	3.70	+0.57	1.5
Bissett, Ont	29.42	30.04	+.03	43.4	+ 0.6	56.1	30.7	1.43	−1.00	0.4
Ottawa, Ont	29.67	29.99	−.02	48.9	+ 5.1	57.0	40.8	3.51	+0.96	T.
Kingston, Ont.	29.70	30.01	−.02	51.3	+ 4.3	58.6	43.9	3.22	+0.49	1.4
Toronto, Ont	29.66	30.04	.00	50.8	+ 4.2	59.5	42.1	2.77	+0.41	1.2
White River, Ont	28.65	29.98	.00	39.5	+ 2.4	52.0	26.9	2.54	+0.19	2.0
Port Stanley, Ont	29.42	30.06	+.01	50.5	+ 2.7	58.6	42.4	2.60	−0.38	3.6
Saugeen, Ont.	29.33	30.04	+.02	49.6	+ 3.5	57.7	41.6	2.64	−0.53	0.3
Parry Sound, Ont	29.27	29.97	−.04	47.4	+ 3.5	56.4	38.4	4.79	+0.87	1.0
Port Arthur, Ont.	29.27	29.98	.00	43.4	+ 3.5	52.4	34.4	2.71	+0.15	1.0
Winnipeg, Man	29.10	29.94	−.04	45.0	+ 5.9	56.8	33.1	0.69	−1.01	T.
Minnedosa, Man	28.14	29.97	.00	44.8	+ 7.0	56.1	33.5	1.43	+0.23	0.0
Qu'Appelle, Assin.	27.66	29.91	−.06	45.5	+ 6.1	56.7	34.2	0.47	−0.63	1.0
Medicine Hat, Assin	27.65	29.93	−.04	50.2	+ 5.4	65.1	35.2	0.05	−0.53	0.5
Swift Current, Assin	27.38	29.96	−.01	47.0	+ 4.9	60.5	33.4	0.14	−0.74	T.
Calgary, Alberta	26.37	29.91	−.04	44.6	+ 4.5	59.1	30.1	T.	−0.48	T.
Banff, Alberta	25.39	30.01	+.06	41.3	+ 2.0	50.7	31.9	0.72	−0.30	1.0
Edmonton, Alberta	27.55	29.84	−.09	46.2	+ 5.1	60.0	32.4	1.21	+0.51	7.1
Prince Albert, Sask.	28.30	29.87	−.10	41.7	+ 4.6	52.6	30.8	1.05	+0.22	9.0
Battleford, Sask	28.17	29.92	−.05	43.4	+ 3.8	57.2	29.6	0.34	−0.11	0.1
Kamloops, B. C.	28.76	29.99	+.03	46.5	− 0.5	55.1	37.9	0.44	−0.17	0.0
Victoria, B. C.	29.97	30.07	+.06	51.2	+ 2.0	57.0	45.5	1.77	−0.60	
Barkerville, B. C.	25.64	29.92	−.02	36.7	− 3.0	43.1	30.3	0.76	−1.94	0.8
Hamilton, Bermuda	29.85	30.01	−.01	72.6	− 0.4	76.9	68.3	9.83	+3.12	
Dawson City, Yukon										

TABLE VII.—*Heights of rivers referred to zeros of gages, October, 1903.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Mississippi River.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
St. Paul, Minn	1,954	14	13.5	14	7.3	31	10.4	6.2
Red Wing, Minn	1,914	14	11.0	15	7.5	31	9.2	3.5
Reeds Landing, Minn.	1,884	12	9.9	13	6.2	31	8.1	3.7
La Crosse, Wis	1,819	12	11.2	15-17	8.3	31	9.8	2.9
Prairie du Chien, Wis	1,759	18	13.0	18-20	9.9	31	11.6	3.1
Dubuque, Iowa	1,699	15	15.6	1	11.0	11, 12, 31	12.6	4.6
Leclaire, Iowa	1,609	10	10.7	1	7.1	14, 15	8.2	3.6
Davenport, Iowa	1,593	15	13.6	1	9.3	15	10.8	4.3
Muscatine, Iowa	1,562	16	14.7	4	11.0	16, 17	12.5	3.7
Galland, Iowa	1,472	8	7.7	7	5.6	19, 20	6.5	2.1
Keokuk, Iowa	1,463	15	14.3	7	10.0	19-20	11.6	4.3
Hannibal, Mo	1,402	13	15.8	10	11.6	21	13.2	4.2
Grafton, Ill	1,306	23	16.9	12	12.9	24, 25	14.5	4.0
St. Louis, Mo	1,264	30	22.5	11	15.6	31	18.5	6.9
Chester, Ill	1,189	30	18.4	12	12.7	31	15.1	5.7
Mississippi River.—Cont'd.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet
New Madrid, Mo	1,003	34	17.0	14, 15	12.8	31	14.6	4.2
Memphis, Tenn	843	33	13.2	16, 17	9.5	31	10.9	3.7
Helena, Ark	767	42	18.8	17-19	14.6	31	16.2	4.2
Arkansas City, Ark	635	42	20.6	20	16.1	5-9	17.8	4.5
Greenville, Miss	595	42	16.2	20, 21	12.8	6-10	14.1	3.4
Vicksburg, Miss	474	45	17.6	22, 23	13.9	9-12	15.5	3.7
Natchez, Miss	373	46	18.1	1, 23, 24	14.7	10, 11	16.3	3.4
Baton Rouge, La	240	35	10.5	24, 25	7.7	10-12	9.1	2.8
Donaldsonville, La	188	28	7.3	24	5.2	11	6.3	2.1
New Orleans, La	108	16	5.7	4	4.5	18	5.0	1.2
Yellowstone River.								
Glendive, Mont	98	17	2.1	6	1.4	31	1.8	0.7
James River.								
Lamoure, N. Dak		25	− 0.2	1-3	− 0.8	25-31	−0.6	0.6
Huron, S. Dak	210	9	1.0	10	0.4	22	0.6	0.6

TABLE VII.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Missouri River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Townsend, Mont	2,504	10	3.9	8–31	3.7	1,2	3.9	0.2
Fort Benton, Mont	2,285	12	1.3	14,15,17-19	0.9	1,2	1.2	0.4
Bismarck, N. Dak	1,309	14	1.8	1	1.2	8	1.5	0.6
Pierre, S. Dak	1,114	14	3.5	1	1.8	25,26	2.4	1.7
Sioux City, Iowa	784	19	7.7	7	5.4	31	6.3	2.3
Omaha, Nebr	669	18	8.9	8	7.0	31	8.0	1.9
St. Joseph, Mo	481	10	4.0	10	1.6	28	3.1	2.4
Kansas City, Mo	388	21	10.3	10	8.0	31	9.2	2.3
Boonville, Mo	199	20	11.5	9	7.7	31	9.2	3.8
Hermann, Mo	103	24	13.0	10	7.4	31	9.7	5.6
Illinois River.								
Peoria, Ill	135	14	11.5	10-14	10.2	31	11.1	1.3
Youghiogheny River.								
Confluence, Pa	59	10	1.0	9–10	– 0.4	1–6	0.2	1.4
West Newton, Pa	15	23	1.8	10	0.0	1–4	0.5	1.8
Allegheny River.								
Warren, Pa	177	14	4.2	9	0.8	4–6	1.7	3.4
Oil City, Pa	123	13	4.4	9	0.8	1,2	1.9	3.6
Parker, Pa	73	20	5.7	10	0.5	3	2.0	5.2
Freeport, Pa	29	20	11.0	9	1.6	31	4.0	9.4
Clarion River.								
Clarion, Pa	32	10	5.4	9	0.2	2	1.7	5.2
Monongahela River.								
Weston, W. Va	161	18	– 1.1	6–8	– 1.4	30,31	–1.3	0.3
Fairmont, W. Va	119	25	13.2	29–31	1.3	1,3–5	9.0	11.9
Greensboro, Pa	81	18	7.1	11	6.0	1–6	6.4	1.1
Lock No. 4, Pa	40	28	8.4	12,13	6.1	31	6.8	2.3
Conemaugh River.								
Johnstown, Pa	64	7	3.1	9	0.7	1-4, 23–31	1.3	2.4
Red Bank Creek.								
Brookville, Pa	35	8	1.7	9	0.2	1–7	0.6	1.5
Beaver River.								
Ellwood Junction, Pa	10	14	2.5	10–12	1.3	30,31	1.9	1.2
Great Kanawha, River.								
Charleston, W. Va	58	30	7.0	21	6.5	7,30,31	6.7	0.5
Little Kanawha River.								
Glenville, W. Va	103	20	2.5	9	– 2.8	1	–0.4	5.3
New River.								
Radford, Va	155	14	0.0	8–24	– 0.3	6,28–31	–0.1	0.3
Hinton, W. Va	95	14	1.9	11	1.1	5–7	1.3	0.8
Cheat River.								
Rowlesburg, W. Va	36	14	3.6	9	0.7	3	1.9	2.9
Ohio River.								
Pittsburg, Pa	966	22	7.1	10	3.2	14	5.8	3.9
Davis Island Dam, Pa	960	25	8.7	10	2.4	1,2	4.3	6.3
Beaver Dam, Pa	925	27	11.1	10	2.7	2	5.3	8.4
Wheeling, W. Va	875	36	10.3	11	2.2	4	4.8	8.1
Parkersburg, W. Va	785	36	11.0	12	2.6	7	5.1	8.4
Point Pleasant, W. Va	703	39	8.7	13	1.5	5–7	3.4	7.2
Huntington, W. Va	660	50	11.8	14	3.8	7	6.2	8.0
Catlettsburg, Ky	651	50	10.6	14	1.5	6,7	4.1	9.1
Portsmouth, Ohio	612	50	11.3	14	3.0	7	5.3	8.3
Cincinnati, Ohio	499	50	11.7	16	4.5	7	6.6	7.2
Madison, Ind	413	46	9.8	17	4.4	13,14	6.0	5.4
Louisville, Ky	367	28	5.8	18	3.0	7	3.8	2.8
Evansville, Ind	184	35	6.8	21	2.9	17	4.1	3.9
Paducah, Ky	47	40	6.0	15	3.7	1. 4–7, 31	4.6	2.3
Cairo, Ill	1,073	45	20.5	14,15	15.5	31	17.7	5.0
Muskingum River.								
Zanesville, Ohio	70	20	8.2	10	5.3	1,2,4	7.0	2.9
Scioto River.								
Columbus, Ohio	110	17	2.4	11–15	1.8	5–7	2.2	0.6
Miami River.								
Dayton, Ohio	77	18	1.3	11	0.7	1–5, 23, 25, 27, 28	0.8	0.6
Wabash River.								
Mount Carmel, Ill	50	15	2.6	12	0.4	2,3	1.4	2.2
Licking River.								
Falmouth, Ky	30	25	1.2	9,10	0.2	1–8, 27–31	0.5	1.0
Kentucky River.								
High Bridge, Ky	117	17	9.9	9	8.8	1–7	9.0	1.1
Frankfort, Ky	65	31	6.0	14,15	5.0	1–4	5.5	1.0
Clinch River.								
peers Ferry, Va	156	20	– 1.0	2,3,19	– 1.2	6, 7, 9, 10, 13, 14, 16, 22, 23, 25, 26, 29, 30	–1.1	0.2
Clinton, Tenn	52	25	2.9	9,10	2.2	24,25,30,31	2.5	0.7
Holston River.								
Bluff City, Tenn	170	15	0.2	9-11	0.0	1-7,15,16, 22–31	0.0	0.2
Rogersville, Tenn	103	14	1.3	9–11, 18–22	1.1	1, 2, 8, 13, 14, 28–31	1.2	0.2
French Broad River.								
Asheville, N. C	144	6	0.3	9	– 0.8	27–31	–0.6	1.1
Leadvale, Tenn	70	15	0.4	10	– 1.6	1,2,7	–0.7	2.0
Hiwassee River.								
Charleston, Tenn	18	22	2.0	9	0.2	5, 15, 16, 24–26	0.4	1.8
Tennessee River.								
Knoxville, Tenn	635	29	0.8	11	– 0.5	5–7	0.0	1.3
Kingston, Tenn	556	25	1.2	10	0.5	1–8	0.7	0.7
Chattanooga, Tenn	452	33	1.5	10	0.6	1–7, 28–30	0.9	0.9
Bridgeport, Ala	402	24	0.5	11–13	– 0.1	28–30	0.1	0.6
Florence, Ala	255	16	0.4	17	– 0.5	5–7	–0.3	0.9
Riverton, Ala	225	25	– 1.0	10	– 2.0	4–7	–1.6	1.0
Johnsonville, Tenn	95	24	0.6	19,20	– 0.2	9	0.2	0.8
Cumberland River.								
Burnside, Ky	516	50	2.5	10	0.2	3–6	1.2	2.3
Carthage, Tenn	305	40	1.2	11	– 0.1	3–5, 31	0.4	1.3
Nashville, Tenn	189	40	1.7	9–11, 13, 14	0.7	4, 5. 31	1.2	1.0
Clarksville, Tenn	126	42	1.2	12	0.1	3–6	0.5	1.1
Arkansas River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Wichita, Kans	832	10	0.9	31	0.3	28–30	0.5	0.6
Webbers Falls, Ind. T	465	23	6.1	12	2.4	1,2	3.5	3.7
Fort Smith, Ark	403	22	6.5	13	2.1	1,2	3.9	4.4
Dardanelle, Ark	256	21	5.8	16	1.6	3,4	3.3	4.2
Little Rock, Ark	176	23	6.4	17	3.5	1–4, 31	4.7	2.9
White River.								
Newport, Ark	150	26	2.5	13,14	1.0		1.8	1.5
Yazoo River.								
Yazoo City, Miss	80	25	– 2.2	1–4	– 2.4	12–31	–2.4	0.2
Red River.								
Arthur City, Tex	638	27	14.0	1	4.8	30,31	7.3	9.2
Fulton, Ark	515	28	17.4	9	6.0	31	10.1	11.4
Shreveport, La	327	29	7.9	12	– 1.3	3,4	2.7	9.2
Alexandria, La	118	33	8.0	16	0.3	8	3.2	7.7
Ouachita River.								
Camden, Ark	304	39	23.5	8	4.4	31	8.4	19.1
Monroe, La	122	40	10.3	14	2.0	6,7	4.4	8.3
Atchafalaya River.								
Melville, La	100	31	16.3	22–24	12.7	10	14.9	3.6
Passaic River.								
Chatham, N. J	69	......	7.2	11	2.3	8	3.8	4.9
Pompton River.								
Pompton Plains, N. J	6	......	14.3	10	4.0	1–8	5.6	10.3
Susquehanna River.								
Binghamton, N. Y	306	16	17.6	11	2.9	1	6.2	14.7
Towanda, Pa	262	16	15.2	11	0.5	1	4.6	14.7
Wilkesbarre, Pa	183	17	21.8	12	3.6	1–5	8.9	18.2
Harrisburg, Pa	69	17	11.2	12	1.4	7	4.7	9.8
West Branch Susquehanna.								
Lockhaven, Pa	65	12	3.5	10	0.0	5	1.0	3.5
Williamsport, Pa	39	20	7.8	10	0.9	3,4	3.2	6.9
Juniata River.								
Huntingdon, Pa	90	24	5.0	9	3.0	1–5	3.6	2.0
Shenandoah River.								
Riverton, Va	58	22	0.6	8	– 0.4	1–7	0.1	1.0
Potomac River.								
Cumberland, Md	290	8	2.4	17	0.8	1	1.6	1.6
Harpers Ferry, W. Va	172	18	1.8	9	– 0.2	8,31	0.4	2.0
James River.								
Lynchburg, Va	260	18	2.0	8	0.3	4–7	0.6	1.7
Richmond, Va	111	12	2.0	11	– 1.2	18	0.1	3.2
Dan River.								
Danville, Va	55	8	1.0	9	– 0.3	1–8	0.4	1.3
Roanoke River.								
Clarksville, Va	196	12	5.5	10	2.7	31	3.2	2.8
Weldon, N. C	129	30	12.4	11	8.8	7	9.4	3.6
Cape Fear River.								
Fayetteville, N. C	112	38	8.5	19	0.8	8	2.8	7.7
Edisto River.								
Edisto, S. C	75	6	4.8	1	3.0	15–20, 31	3.6	1.8
Pedee River.								
Cheraw, S. C	149	27	6.0	18	1.4	6–8	2.4	4.6
Black River.								
Kingstree, S. C.[1]	52	12	7.0	1	1.8	16	3.9	5.2
Lynch Creek.								
Effingham, S. C	35	12	6.0	25,26	3.0	8	4.2	3.0
Santee River.								
St. Stephens, S. C	97	12	5.6	21	1.1	9	2.3	4.5
Congaree River.								
Columbia, S. C	37	15	1.8	18	0.1	31	0.8	1.7
Wateree River.								
Camden, S. C	45	24	12.0	18	5.2	4–8	6.7	6.8
Waccamaw River.								
Conway, S. C	40	7	2.8	12-14,23,26	1.4	10	2.2	1.4
Savannah River.								
Calhoun Falls, S. C	347	15	3.0	18	2.1	27,29,30	2.4	0.9
Augusta, Ga	268	32	9.3	18	6.5	1, 13, 15, 16, 25	7.0	2.8
Broad River.								
Carlton, Ga	30	11	2.6	18	2.1	28–30	2.2	0.5
Flint River.								
Albany, Ga	80	20	3.4	21	0.8	30,31	1.9	2.6
Chattahoochee River.								
Oakdale, Ga	305	18	0.5	8,19	0.0	1-7,13-17, 26–31	0.2	0.5
Westpoint, Ga	239	20	2.5	9,17,18	2.0	3–8,13-16, 24–31	2.1	0.5
Ocmulgee River.								
Macon, Ga	125	18	4.9	18	2.3	1,2,13,16, 26–31	2.6	2.6
Abbeville, Ga	50	11	4.6	21	1.7	16	2.4	2.9
Oconee River.								
Dublin, Ga	79	20	4.3	19	– 0.1	6	0.6	4.4
Coosa River.								
Rome, Ga	271	30	1.3	18	0.2	7	0.8	1.1
Gadsden, Ga	144	18	0.8	11	– 0.4	1-9,15,16, 28–30	–0.2	1.2
Alabama River.								
Montgomery, Ala	265	35	0.8	9,10,24	0.2	7	0.4	0.6
Selma, Ala	212	35	0.6	18,19,26	– 0.3	7-9	0.2	0.9
Tombigbee River.								
Columbus, Miss	303	33	– 3.5	17,18,21-23,26-29, 31	– 3.7	1-7, 9-11	–3.6	0.2
Demopolis, Ala	155	35	– 2.6	26,31	– 3.3	13–15	–3.0	0.7
Black Warrior River.								
Tuscaloosa, Ala	90	43	5.1	12,13	3.6	5	4.6	1.5
Sabine River.								
Logansport, La	180	25	10.0	17	1.0	1–4	6.1	9.0
Orange, Tex	10	7	1.0	1–3	0.1	4	0.7	0.9
Neches River.								
Rockland, Tex	100	20	2.5	14	– 0.3	1,2	1.0	2.8
Beaumont, Tex	20	15	1.8	3,4	– 0.9	28,29	0.6	2.7

TABLE VII.—*Heights of rivers referred to zeros of gages, October, 1903*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Trinity River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Dallas, Tex	330	25	23.9	7	2.2	30	8.7	21.7
Riverside, Tex	100	40	14.1	13	0.3	1	7.8	13.8
Liberty, Tex	42	25	15.0	17	4.2	3	9.8	10.8
Brazos River.								
Kopperl, Tex	369	21	7.2	7	0.0	22-31	1.3	7.2
Waco, Tex	301	24	16.8	1	2.5	31	5.8	14.3
Hempstead, Tex	215	40	19.0	4	0.3	2	7.4	18.7
Booth, Tex	76	39	14.4	13	0.8	1	7.1	13.6
Colorado River.								
Austin, Tex	214	18	10.2	4	1.3	31	3.0	8.9
Columbus, Tex	100	24	26.0	6	6.2	31	10.2	19.8
Red River of the North.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Moorhead, Minn	418	26	8.5	12, 13	7.5	1, 2	8.1	1.0
Columbia River.								
Umatilla, Oreg	270	25	7.4	9	5.5	31	6.6	1.9
The Dalles, Oreg	166	40	10.4	11	7.4	30, 31	9.0	3.0
Willamette River.								
Albany, Oreg	118	20	3.1	7	1.0	1-4, 27-31	1.5	2.1
Portland, Oreg	12	15	6.2	8	2.7	1, 30	4.5	3.5
Sacramento River.								
Red Bluff, Cal	265	23	1.2	10	−0.1	2-8	0.2	1.3
Sacramento, Cal	64	29	8.7	15	7.0	1	7.5	1.7

[1] 29 days.

HAWAIIAN CLIMATOLOGICAL DATA.

By R. C. LYDECKER, Territorial Meteorologist.

Rainfall data for October, 1903.

Stations.	Elevation.	Amount.
HAWAII.		
HILO, e. and ne.	*Feet.*	*Inches.*
Waiakea	50	12.37
Hilo (town)	100	11.21
Kaumana	1,250	14.62
Pepeekeo	100	11.13
Hakalau	200	10.45
Honohina	300	10.76
Puuohua	1,050	17.32
Laupahoehoe	500	17.80
Ookala	400	9.85
HAMAKUA, ne.		
Kukaiau	250	6.73
Paauilo	300	6.64
Paauhau	300	4.93
Honokaa (Mill)	425	5.62
Honokaa (Meinicke)	1,100	9.27
Kukuihaele	700	5.94
KOHALA, n.		
Awini Ranch	1,100	8.91
Niulii	200	4.96
Kohala (Mission)	521	3.96
Kohala (Sugar Co.)	270	3.86
Hawi, Mill	700	3.55
Puakea Ranch	600	2.28
Puuhue Ranch	1,847	2.69
Waimea	2,720	2.65
KONA, w.		
Huehue	2,000	1.50
Holualoa	1,350	3.47
Kaukahoku Leheula	......	......
Kainaliu	......	......
Kealakekua	1,580	5.13
Napoopoo	25	0.90
Hoopuloa	1,650	......
Hoopuloa	2,300	6.25
Puuwaawaa Ranch	2,700	0.06
Huehue	......	......
KAU, se.		
Kahuku Ranch	1,680	1.39
Honuapo	15	0.53
Naalehu	650	0.85
Hilea	310	0.20
Pahala	850	......
Moaula	1,700	......
Volcano House	4,000	3.88
PUNA, e.		
Olaa, Mountain View (Russel)	1,690	......
Olaa (Plantation)	......	......
Kapoho	110	2.03
Pahoa	600	6.80
MAUI.		
Lahaina	40	......
Waiopae Ranch	700	......
Kaupo (Mokulau), s	285	4.34
Kipahulu, s	308	5.70
Hana	......	......
Nahiku, ne	850	16.57
Nahiku	1,600	......
Haiku, n	700	7.61
Kula (Erehwon), n	4,500	3.55
Kula (Waiakoa), n	2,700	3.17
Puuomalei, n	1,400	7.53
Paia	189	......
Haleakala Ranch	2,000	4.21
MAUI—Cont'd.	*Feet.*	*Inches.*
Wailuku, ne	250	3.61
LANAI.		
Keomuku	10	3.75
OAHU.		
Punahou (W. B.), sw	47	2.16
Kulaokahua (Castle), sw	50	1.20
Makiki Reservoir	120	2.21
U. S. Naval Station, sw	6	0.93
Kapiolani Park, sw	10	0.72
College Hills	175	2.93
Manoa (Woodlawn Dairy), c	285	6.75
Manoa (Rhodes Gardens)	360	7.75
Insane Asylum	30	1.12
School street (Bishop), sw	......	......
Kamehameha School	75	......
Kalihi-Uka, sw	485	......
Nuuanu (W. W. Hall), sw	50	2.06
Nuuanu (Wyllie street)	250	3.18
Nuuanu (Elec. Station), sw	405	2.91
Nuuanu (Luakaha), c	850	7.89
U. S. Experiment Station	350	2.87
Kaliula	1,150	6.40
Laniakea (Nahuina)	1,150	......
Tantalus Heights (Frear)	1,360	6.69
Waimanalo, ne	25	1.96
Maunawili, ne	300	3.19
Kaneohe	100	2.66
Ahuimanu, ne	350	4.80
Kahuku, n	25	......
Waialua	37	......
Wahiawa	900	2.36
Ewa Plantation, s	60	......
U. S. Magnetic Station	45	......
Waipahu	200	0.77
Moanalua	15	1.37
Pacific Heights	700	......
KAUAI.		
Lihue (Grove Farm), e	200	3.13
Lihue (Molokoa), e	300	3.39
Lihue (Kukaua), e	1,000	5.78
Kealia, e	15	......
Kilauea (Plantation), ne	325	8.82
Hanalei, n	10	10.69
Waioli	10	......
Haena	15	......
Waiawa	32	1.47
Eleele	150	2.41
Wahiawa (Mountain)	3,000	12.00
McBryde (Residence)	850	6.59
Lawai (Gov. Road)	450	6.88
Lawai, w	225	2.16
Lawai, e	800	6.56
Koloa	100	3.30
Delayed September reports.		
Waiawa	......	1.60
Puuwaawaa Ranch	......	2.88
Hoopuloa	1,650	6.05
Hoopulo	2,300	9.02
Kulr (Erehwon)	......	5.04
Kealia	......	1.19
Hilo	......	15.69
Honokaa (Meinicke)	1,100	2.89

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

Meteorological Observations at Honolulu, October, 1903.

The station is at 21° 18′ N., 157° 50′ W. It is the Hawaiian Weather Bureau station Punahou. (See fig. 2, No. 1, in the MONTHLY WEATHER REVIEW for July, 1902, page 365.)

Hawaiian standard time is 10^h 30^m slow of Greenwich time. Honolulu local mean time is 10^h 31^m slow of Greenwich.

The pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

Rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature. Dry bulb.	Temperature. Wet bulb.	During twenty-four hours preceding 1 p. m. Greenwich time, or 2:30 a. m. Honolulu time. Temperature. Maximum.	Temperature. Minimum.	Means. Dew-point.	Means. Relative humidity.	Wind. Prevailing direction.	Wind. Force.	Average cloudiness.	Sea-level pressures. Maximum.	Sea-level pressures. Minimum.	Total rainfall at 9 a. m., local time.
	*	†	†			‡	‡		§				
1	30.01	75	70	81	75	67.0	72	ene.-ne.	4-3	8-4	30.03	29.94	0.02
2	30.03	76	69	82	73	67.0	71	ne.	1-4	3-7	30.07	29.98	0.02
3	30.02	75	69	81	74	65.7	69	ne.	4	4	30.07	30.00	T.
4	29.99	75	69	80	72	65.5	73	ne.	3-4	7-3	30.06	29.96	0.20
5	30.01	75	69.5	80	73	67.0	74	ne.	4-5	4	30.02	29.94	0.07
6	30.02	75	69	81	73	68.0	76	ne.	4-5	3-6	30.05	29.99	0.10
7	30.02	75	67	80	73	65.7	71	ne.	5	4-8	30.05	30.00	0.08
8	30.03	75	68	80	74	63.3	65	ne.	4-5	7-4	30.07	30.01	0.03
9	30.01	75	68	80	73	62.7	64	ne.	5	4	30.07	30.00	0.04
10	29.98	68	66	80	71	64.5	70	ne.	3	5	30.05	29.97	T.
11	30.00	69	66.5	82	67	64.7	75	sw.-w.	1-0	4-0	30.02	29.95	T.
12	30.00	64	62.5	82	67	64.3	74	calm.	0	0-4-0	30.02	29.95	0.00
13	29.94	71	69	83	64	64.0	76	w.	1-0	1-0	30.01	29.89	0.00
14	29.77	74	72	79	68	70.7	93	s.-sw.	1-0	4-10	29.91	29.77	0.05
15	29.75	71	69.5	75	71	70.5	91	sw.	0	‖	29.80	29.72	0.26
16	29.84	71	68.5	77	70	66.7	79	ne.	2-0	‖	29.86	29.77	0.15
17	29.92	69	68	83	69	68.7	84	s.	1-0	7-3	29.96	29.83	0.01
18	29.95	70	68	83	68	67.7	76	ne.	0-2	3	30.01	29.92	0.00
19	29.94	73	68.5	82	70	66.7	74	ne.	1-0	1	30.01	29.93	0.00
20	29.89	69	67.5	82	69	67.0	76	ne.	2-0	4	29.98	29.90	0.00
21	29.92	68	67	83	68	68.0	81	s.	1-0	2-7-2	29.95	29.83	0.00
22	29.97	68	65.5	82	67	66.7	76	sw.	1-0	0-4	30.01	29.90	0.00
23	29.98	73	69	82	67	65.7	78	ne.	1-0	3-10	30.03	29.94	0.00
24	29.93	71	67	79	70	66.0	75	nne.-ne.	3-5	3	30.01	29.92	0.56
25	29.97	73	65	80	70	63.5	69	ne.-nne.	1-4	2	30.00	29.93	0.00
26	30.01	74	66.5	79	72	61.0	63	nne.-ne.	4	1	30.04	29.95	T.
27	30.04	74	67	78	73	63.0	67	ne.	2	3-6-1	30.06	30.01	0.00
28	30.05	72	67	79	71	62.3	64	ne.	3-5	4-6	30.07	30.01	0.14
29	30.03	72	68	79	71	65.3	75	ne.	3	3-9-5	30.07	29.98	0.03
30	30.03	72	67	79	71	64.0	70	ne.	3	6-9-5	30.07	29.99	0.38
31	30.02	71	66.5	80	72	64.7	71	ne.	2-0	3-9	30.05	29.96	0.02
Sums	......	......	......	......	......	......	......	......	......	......	......	......	2.16
Means	29.970	72.0	67.7	80.4	70.5	65.7	73.9	......	2.3	4.3	30.016	29.930	......
Departure	+.005	......	......	......	......	−0.4	+3.4	......	......	0	......	......	−0.59

Mean temperature for the month of October, 1903, $(6+2+9) \div 3 = 75.1°$; normal is 76.2°. Mean pressure for the month of October, 1903, $(9+3) \div 2 = 29.972$; normal is 29.967.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4.31 p. m., Greenwich time. ‡ These values are the means of $(6+9+2+9) \div 4$. § Beaufort scale.

Maximum thermometer set at 9 p. m. and minimum at 2 p. m., local time.

‖ 7-10-8.

Temperature table for October, 1903.

Stations.	Elevation.	Mean max.	Mean min.	Cor. av'ge.	Highest.	Lowest.
	Feet.	°	°	°	°	°
Hilo	40	82.4	66.7	73.9	87	62
Pepeekeo	100	78.9	69.7	73.6	83	68
Kohala	521	79.4	67.6	72.8	85	64
Naalehu	1,903	76.0	62.0	68.3	80	58
Waimea	2,730	73.4	60.5	66.2	82	53
Volcano House	4,000	73.1	53.6	62.7	80	51
Waiakoa	2,700	81.4	58.6	69.3	89	54
W. R. Castle	50	80.6	71.4	75.1	84	66
Ewa Plantation	60	83.0	68.0	74.9	86	61
United States Experimental Station	350	81.3	69.8	75.0	86	69

GENERAL SUMMARY FOR OCTOBER, 1903.

Honolulu.—Temperature mean for the month, 75.1°; normal, 76.2°; average daily maximum, 80.4°; average daily minimum, 70.5°; mean daily range, 9.9°; greatest daily range, 19° (12th); least daily range, 4° (14th); highest temperature, 83° (several); lowest temperature, 64° (12th).

Barometer average, 29.972; normal, 29.967; highest, 30.07; (several); lowest, 29.72 (14th); greatest 24-hour change, that is from any given hour of one day to the same hour on the next, .13 (12th to 13th); lows passed this point, 13th to 16th, inclusive, and 20th; highs, 1st to 3d, 7th to 9th, and 26th to 31st, inclusive.

Relative humidity average, 73.9 per cent; normal, 70.5 per cent; mean dew-point, 65.7°; normal, 66°; mean absolute moisture, 6.87 grains per cubic foot; normal, 7.06 grains.

Rainfall, 2.16 inches; normal, 2.75 inches; rain record days, 17; normal, 20; greatest rainfall in one day, 0.56 (from 9 a. m. 22d to 9 a. m. 23d); total at Luakaha, 7.89; normal, 11.69; at Kapiolani Park, 0.72; normal, 1.12.

The artesian well water level rose during the month from 33.10 to 33.30 feet above mean sea level; October 31, 1902, it stood at 32.95. The average daily mean sea level for the month was 9.94 feet, the assumed annual mean being 10.00 feet above datum; for October, 1902, it was 10.05.

Trade wind days, 23, (one of nne.); normal, 22; average force of wind during daylight, Beaufort scale, 2.3; average cloudiness, tenths of sky, 4.3; normal, 4.3.

Approximate percentages of district rainfall as compared with normal: Hawaii, Hilo district, 96 per cent; Hamakua, 126; Kohala, 109; Waimea, 83; Kona, 79; Kau, 23; Puna, 23; Island of Maui, variable from 137 at Puuomalei to 280 per cent at Wailuku; Oahu, 60; Southeast Kauai, 87; North and West Kauai, 187.

The heaviest 24-hour rainfalls for the month were at Hilo, 3.99, (5th); Nahiku, Maui, 5.84 (25th); and Waiakea, Hawaii, 5.85 inches, (5th). The heaviest monthly rainfall reported was at Laupahoehoe, Hawaii, 17.80 inches.

Naalehu; mean relative humidity, 74 per cent; barometer average, 29.39; lowest, 29.24; highest, 29.49; greatest 24-hour change, 13.

Kohala; dew-point, 66.0°; relative humidity, 77.4 per cent.

Ewa plantation; dew-point, 63.0°; relative humidity, 65.2 per cent; barometer average, 29.97.

The principal features of the month were the eruption of Mauna Loa, the heavy electric storm on Maui and Lanai and the low average temperature. Smoke was first observed issuing from the crater of Mauna Loa (Mokuaweoweo) at 12:45 p. m. on the 6th, and activity has continued up to the present time. At the close of the month the lava lake was reported to have risen to within 700 feet of the crater's rim, but as this is an eye estimate due allowance must be made; the best authority gives an estimated rise of the lava as from 25 to 30 feet above the floor of the crater, which when the volcano was not in an active state, was 800 feet below the crater's summit. This crater is oblong in shape being 3.7 miles long and 1.74 miles in width. The mountain has thus far withstood the pressure from within, and no outbreak from its sides has occurred, hence no flow of lava. In connection with this eruption the report of Captain Coath of the British ship *Ormsary* is of more than passing interest. Captain Coath reports having experienced a remarkable disturbance of the sea lasting from the afternoon of the 5th to the morning of the 6th, currents and high cross seas in every direction, the vessel making no headway and unmanageable, Mauna Loa bearing east-southeast distant about 80 miles, on the afternoon of the 6th the activity of the volcano was noticed from the ship. There are no reports of earthquakes previous to the outbreak which occurred without warning, and an interesting question arises as to whether this disturbed condition of the sea was the result of a cause, or an effect of volcanic activity.

The electric storm on Maui began on the afternoon of the 14th, and lasted until the morning of the 15th, being most severe during the night; considerable damage was done by lightning both on this island and Lanai which also experienced the same storm.

The mean temperature for the month, 75.1°, is the lowest October mean, with one exception (74.7° in 1894), on record during twenty-one years observations at the Weather Bureau, and is 1.1° below the normal for that month. The mean relative humidity was 3.4 above the normal. Dew eight mornings. Bright glow on the morning of the 11th. Smoke haze on southeast horizon 16th. Distant thunder from southeast a. m. and p. m. 14th, and lightning during the night, the latter also reported from Hilo to the northwest (electric storm of 14th and 15th on Maui and Lanai). Thunder morning of the 15th.

Reports from other stations: Hilo, earthquake 6:05 a. m. on the 2d; lightning to northwest on the evening of the 14th; heavy thunder shower on the 16th, Kohala, Hawaii, "Kona" (wind from south-southwest) 14th to 16th, inclusive, trade winds on all other days of the month. Pepeekeo, Hawaii, winds east and east-northeast 19 days, other days from north to northeast; average force, 1.3; heavy surf, 4th to 7th, inclusive, also 28th and 29th; distant lightning, 15th; lunar halo same date, volcanic smoke all day, the latter on the 24th also; thunderstorm from 1 to 7 p. m. 16th, with distant lightning in evening; fine morning and afterglows numerous during the month, with more or less reflection from volcano at night; dew, 7 mornings. Waimea, Hawaii, fresh and strong northeast winds first and last portions of month with gale on the 8th and 9th, calms and light winds 10th to 21st. Naalehu, Hawaii, trade winds 26 days; medium earthquake on the 7th at 2:45 p. m.; eruption of Mauna Loa first observed about 2 p. m. on 6th. Volcano House reports a very dry month.

CLIMATOLOGICAL DATA FOR JAMAICA.

Through the kindness of Mr. H. H. Cousins, chemist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following table in advance of the regular monthly weather report for Jamaica:

Comparative table of rainfall for October, 1903.

[Based upon the average stations only.]

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1903.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	24	8.98	13.44
Northern division	22	53	6.24	7.67
West-central division	26	23	8.40	12.30
Southern division	27	32	5.49	10.42
Means	100	213	7.28	10.96

The rainfall for October was therefore below the average for the whole island. The greatest rainfall, 19.25 inches, occurred at Moore Town, in the northeastern division, while 0.50 inch fell at Denbigh in the southern division.

COSTA RICAN CLIMATOLOGICAL DATA.

Communicated by Mr. H. PITTIER, Director, Physico-Geographic Institute.

TABLE 1.—*Hourly observations at the Observatory, San José de Costa Rica, during October, 1903.*

Hours.	Pressure. Observed, 1903.	Pressure. Normal, 1889-1900.	Temperature. Observed, 1903.	Temperature. Normal, 1889-1900.	Relative humidity. Observed, 1903.	Relative humidity. Normal, 1889-1900.	Rainfall. Observed, 1903.	Rainfall. Normal, 1889-1900.	Rainfall. Duration, 1903.
	Inches.	*Inches.*	° *F.*	° *F.*	%	%	*Ins.*	*Ins.*	*Hrs.*
1 a. m	26.14	26.12	62.8	63.4	94	95	0.12	0.16	3.33
2 a. m	26.13	26.10	62.2	63.0	94	95	0.06	0.14	1.67
3 a. m	26.11	26.09	61.5	62.8	93	95	......	0.12	......
4 a. m	26.11	26.08	61.2	62.3	93	95	......	0.09	......
5 a. m	26.11	26.09	61.0	62.2	93	95	......	0.07	......
6 a. m	26.12	26.10	60.6	61.8	93	95	0.06	0.06	1.00
7 a. m	26.14	26.12	61.0	62.3	92	93	0.09	0.08	1.00
8 a. m	26.15	26.13	64.4	65.6	84	87	0.11	0.07	1.00
9 a. m	26.16	26.14	68.7	68.3	74	80	0.37	0.03	1.17
10 a. m	26.17	26.15	73.2	72.7	67	74	0.51	0.02	1.67
11 a. m	26.16	26.14	74.5	75.4	66	70	0.25	0.03	1.67
Noon	26.14	26.12	76.6	76.3	62	70	0.02	0.11	0.67
1 p. m	26.11	26.10	77.2	75.9	65	72	0.24	0.27	0.67
2 p. m	26.09	26.08	75.3	74.9	68	74	0.20	0.67	2.50
3 p. m	26.08	26.06	73.8	73.0	73	78	1.17	1.26	3.51
4 p. m	26.08	26.06	71.3	70.5	79	84	1.45	1.45	5.50
5 p. m	26.09	26.07	68.4	68.5	86	87	1.88	2.09	7.69
6 p. m	26.10	26.08	67.1	67.1	90	89	1.44	1.84	10.99
7 p. m	26.11	26.10	66.2	66.0	92	93	1.19	1.73	9.00
8 p. m	26.13	26.12	64.3	65.4	93	93	1.10	0.89	5.33
9 p. m	26.15	26.13	65.1	65.0	93	93	0.48	0.59	5.66
10 p. m	26.16	26.14	64.8	64.7	93	94	0.60	0.47	5.00
11 p. m	26.16	26.14	64.2	64.1	93	94	0.36	0.34	5.00
Midnight	26.16	26.13	63.5	63.5	94	94	0.13	0.22	4.67
Mean	26.13	26.11	67.0	67.3	84	87	......	......	......
Minimum	26.01	25.97	56.8	56.1	44	......	......	......	......
Maximum	26.28	26.22	83.8	84.7	100	......	......	......	......
Total	......	......	......	......	......	......	11.83	12.80	76.37

REMARKS.—At San José the barometer is 1169 meters above sea level. Readings are corrected for gravity, temperature, and instrumental error. The hourly readings for pressure, and wet and dry bulb thermometers, are obtained by means of Richard registering instruments, checked by direct observations every three hours from 7 a. m. to 10 p. m. The thermometers are 1.5 meters above ground and are corrected for instrumental errors. The total hourly rainfall is as given by Hottinger's self-register, checked once a day. Under maximum, the greatest hourly rainfall for the month is given. The standard rain gage is 1.5 meters above ground. Since January 1, 1902, observations at San José have been made on seventy-fifth meridian time, which is 0 hours, 36 minutes, 13.3 seconds *in advance* of San José local time. The normals for pressure, temperature, and relative humidity have been adjusted to this time; the normal for rainfall in Table 1 and the sunshine observations and normal in Table 2 refer to local time. At Port Limon the hours of direct observation are 8 a. m., 2 and 8 p. m., San José local time; the barometer is 3.4 meters above sea level. The means for temperature and relative humidity in Table 4 are obtained from two-hourly readings given by a Richard self-registering thermometer.

TABLE 2.—*San José, October, 1903.*

Time.	Sunshine. Observed, 1903.	Sunshine. Normal, 1889-1900.	Cloudiness. Observed, 1903.	Cloudiness. Normal, 1889-1900.	Temperature of the soil at depth of— 6 inches.	12 inches.	24 inches.	48 inches.	120 inches.
	Hours.	*Hours.*	%	%	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
7 a. m	10.96	6.01	50	60	70.1	70.6	71.5	70.9	70.5
8 a. m	25.49	17.68							
9 a. m	26.84	20.99							
10 a. m	26.77	20.90	64	65	70.5	70.6	71.5	71.0	
11 a. m	23.79	18.57							
Noon	16.58	14.09							
1 p. m	15.28	11.39	83	83	71.3	71.0	71.5	71.0	
2 p. m	13.16	10.86							
3 p. m	11.78	8.35							
4 p. m	6.75	4.73	98	95	71.7	71.2	71.5	70.9	
5 p. m	1.91	1.85							
6 p. m		0.23							
7 p. m			98	93	71.5	71.3	71.5	70.8	
8 p. m									
9 p. m									
10 p. m			68	83	71.2	71.2	71.5	70.8	
11 p. m									
Midnight									
Mean			76	80	71.1	71.0	71.5	70.9	70.5
Total	179.31	135.65							

TABLE 3.—*Rainfall at stations in Costa Rica, October, 1903.*

Stations.	Height above sea level.	Observed, 1903. Amount.	Observed, 1903. Number of days.	Averages. Number of years.	Averages. Amount.	Averages. Number of days.
	Feet.	*Inches.*			*Inches.*	
Sipurio (Talamanca)	60	8.66	15	3	7.32	20
Boca Banano	3	5.91	12	7	6.50	15
Port Limon	3			7	5.08	11
Swamp Mouth	3	9.45	9	5	3.58	8
Zent	20	12.56	10	2	5.98	11
Siquirres	60	7.68	7	4	5.71	11
Dos Novillos	122	10.51	18			
Guapiles	300	16.30	18	1	19.25	21
Cariblanco (Sarapiqui)	835	27.17	8	5	23.98	28
San Carlos	161	19.21	20	5	20.67	29
Las Lomas	266	16.54	9	3	11.34	11
Peralta	332	8.86	14	5	13.15	22
Turrialba	620	9.45	7	6	9.21	18
Juan Viñas	1,040	15.95	14	6	8.23	14
Santiago	1,100	7.52	14	2	8.70	21
Paraiso	1,336	12.13	11	2	4.88	15
Cachi	1,020			1	7.20	23
Las Concavas	1,337	7.17	21	2	9.84	18
Cartago	1,451	5.83	18	3	11.02	16
Tres Rios	1,300	13.90	26	13	15.51	22
San Francisco Guadalupe	1,187	13.82	23	7	12.24	23
San José	1,160	11.83	25	14	14.21	25
La Verbena	1,140	9.45	28	7	14.80	24
Nuestro Amo	791	5.28	18	7	10.71	19
Alajuela	950			3	16.30	21
San Isidro Alajuela	1,346	18.90	25	2	22.84	25
Las Cañas	780	9.29	10			

MEXICAN CLIMATOLOGICAL DATA.

By Señor MANUEL E. PASTRANA, Director of the Central Meteorologic-Magnetic Observatory.

October, 1903.

Stations.	Altitude.	Mean barometer.*	Temperature. Max.	Temperature. Min.	Temperature. Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Prevailing direction. Cloud.
	Feet.	*Inches.*	° *F.*	° *F.*	° *F.*	%	*Ins.*		
Chihuahua	4,684	25.25	84.2	46.4	66.0	39	0.97	e. se.	
Guadalajara (Obs. del. Est.)	5,186	24.92	80.6	50.0	66.6	71	3.21	nw.	
Guanajuato	6,640	23.68	84.0	45.3	63.0	61	1.55	ne.	
Leon (Guanajuato)	5,906	24.24	80.8	41.9	62.4	68	1.61	nne.	e.
Mazatlan	25	29.87	90.1	68.9	81.1	74	0.70	nw.	
Merida	50	29.88	95.0	57.9	79.0	79	1.06	ne.	
Mexico (Obs. Cent.)	7,472	23.06	74.8	41.0	58.1	70	1.89	n.	e.
Mexico (E. N. Agric.)	7,442								
Monterey (Seminario)	1,626								
Morelia (Seminario)	6,401	24.05	72.7	44.6	58.3	74	2.69	ne. s.	ne. se.
Pachuca	7,959								
Puebla (Col. Cath.)	7,108	23.37	77.4	42.3	57.9	77	4.12	e. ne.	
Puebla (Col. d Est.)	7,118	23.33	75.2	41.9	58.5	74	4.35	n.	
Queretaro	6,070								
Toluca	8,812								
Zacatecas	8,015	22.55	77.0	37.9	55.8	64	2.89	e.	
Zapotlan	5,078	25.05	81.1	46.4	66.9	70	2.53	sse.	

*The monthly barometric means are reduced to the international standard of gravity.

Chart I. Tracks of Centers of High Areas. October, 1903.

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Chart I. Tracks of Centers of High Areas. October, 1903.

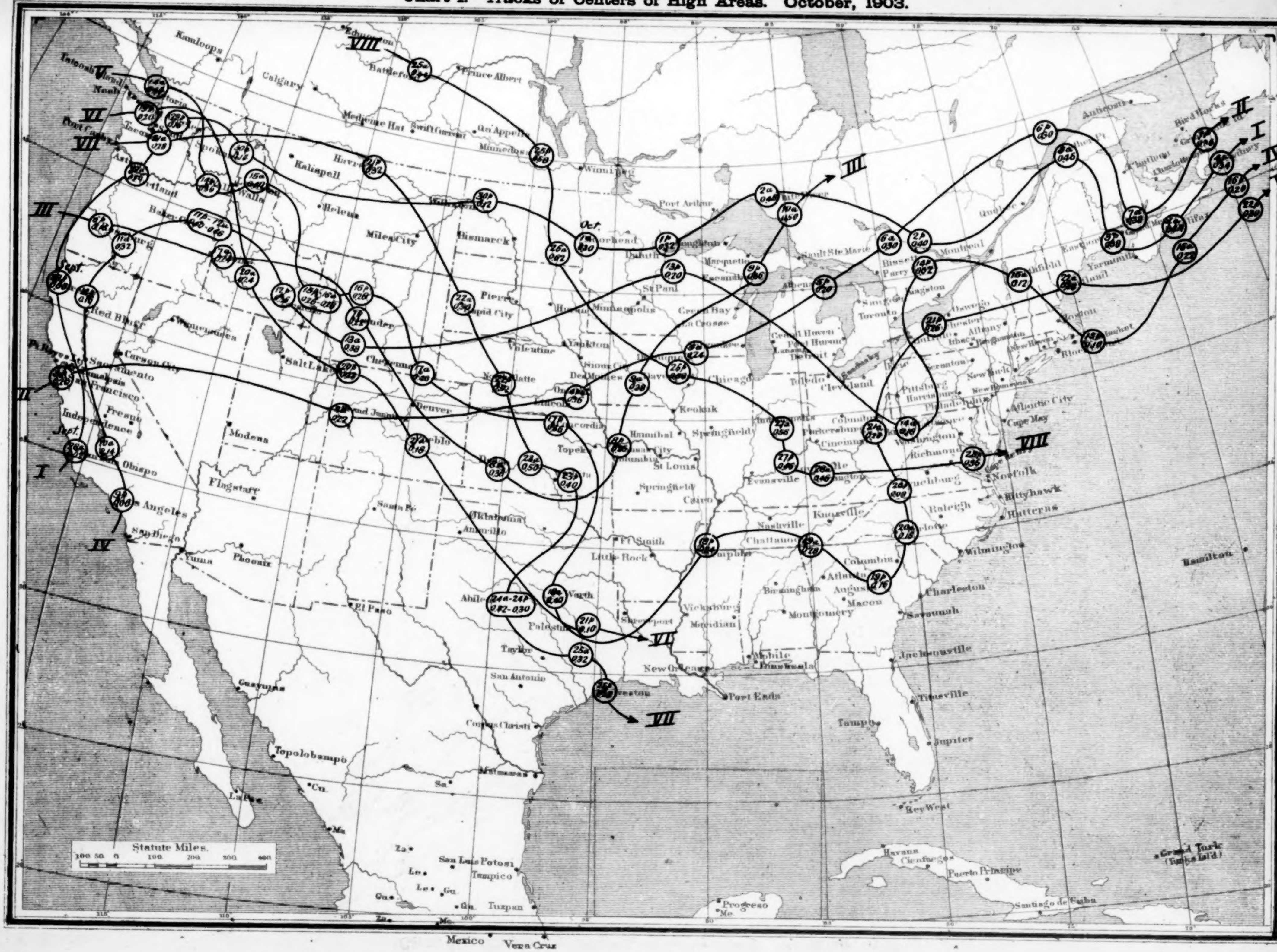

Chart II. Tracks of Centers of Low Areas. October, 1903.

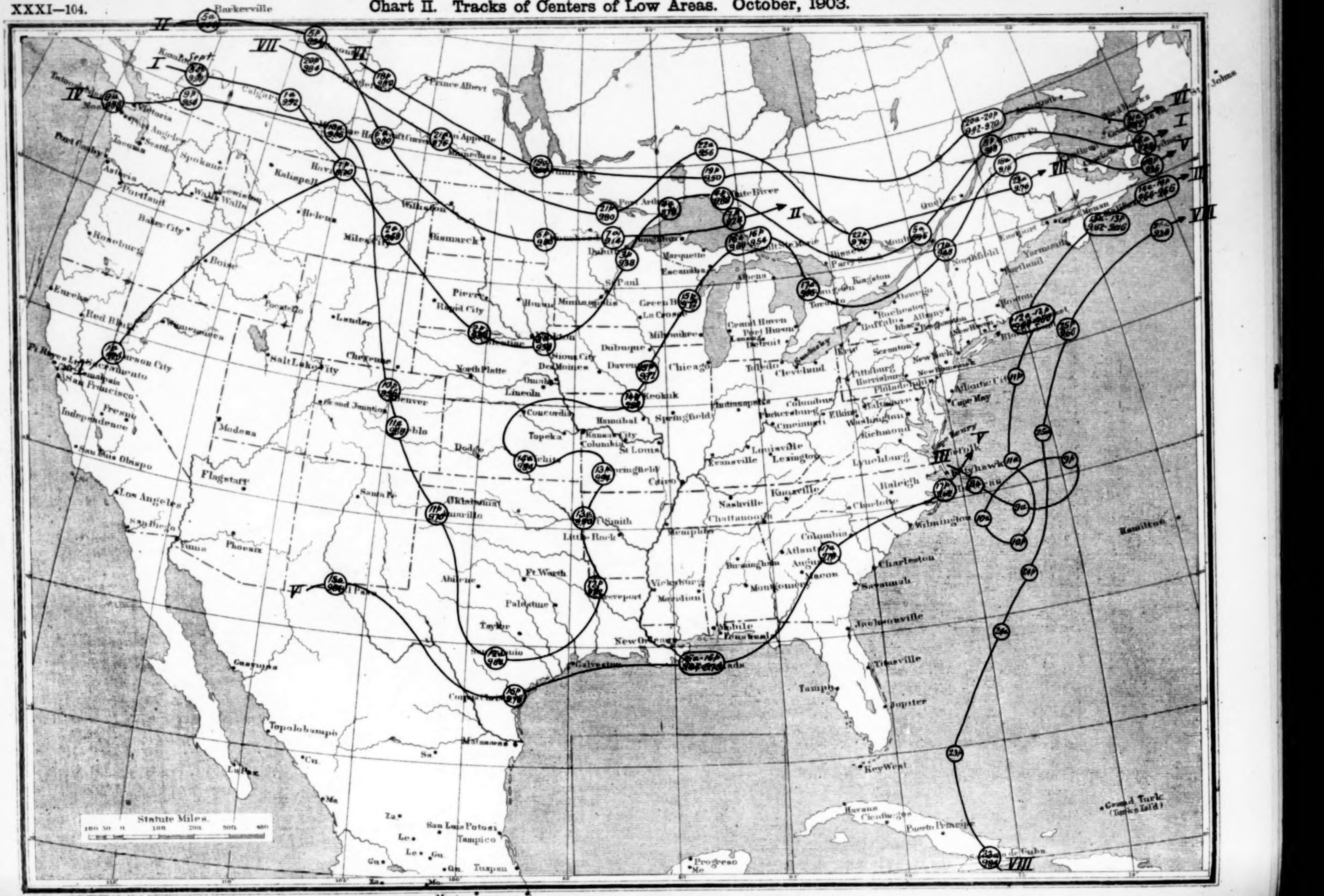

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Chart III. Total Precipitation. October, 1903.

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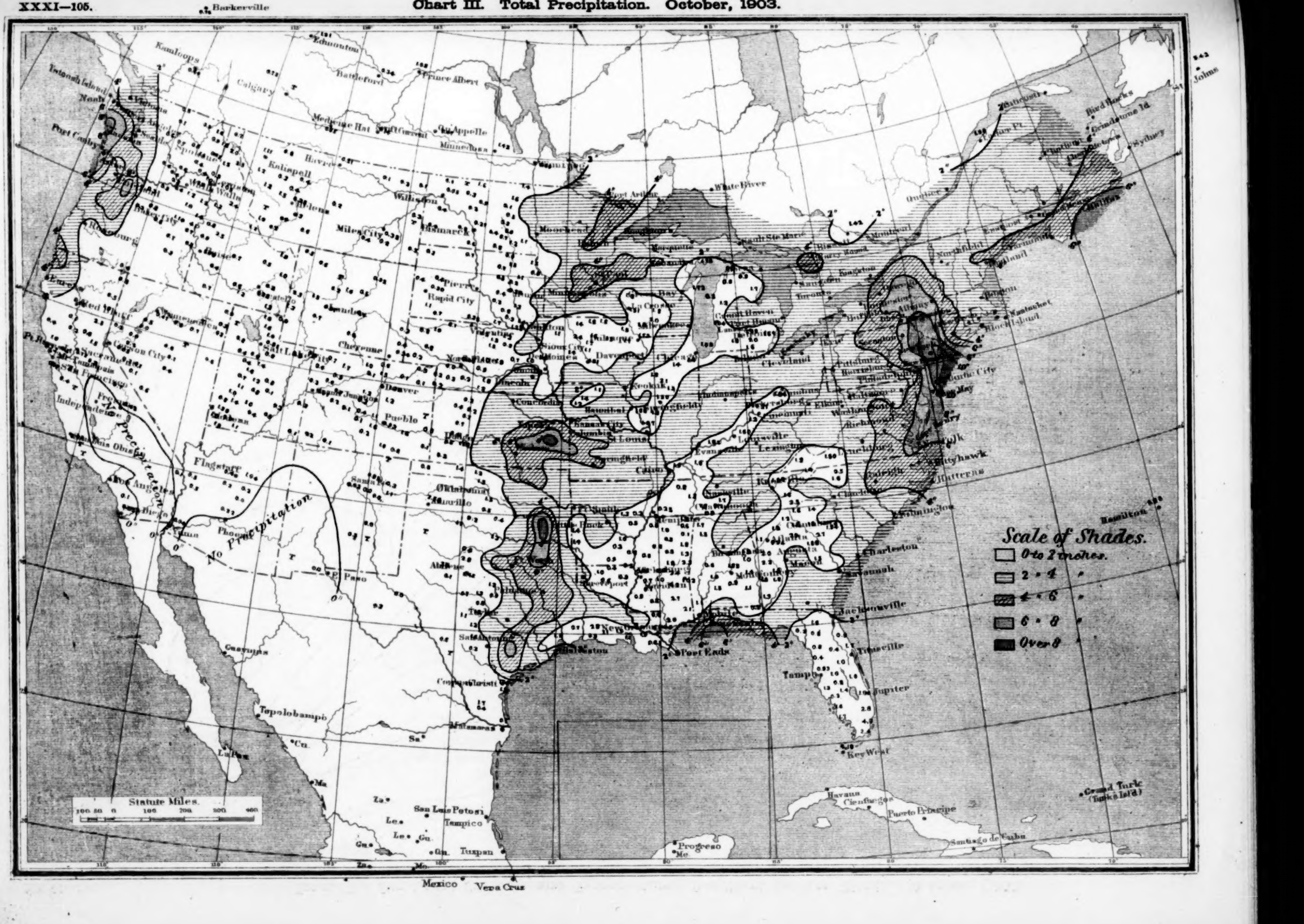

Chart IV. Sea-Level Pressure and Temperature; Resultant Surface Winds. October, 1903.

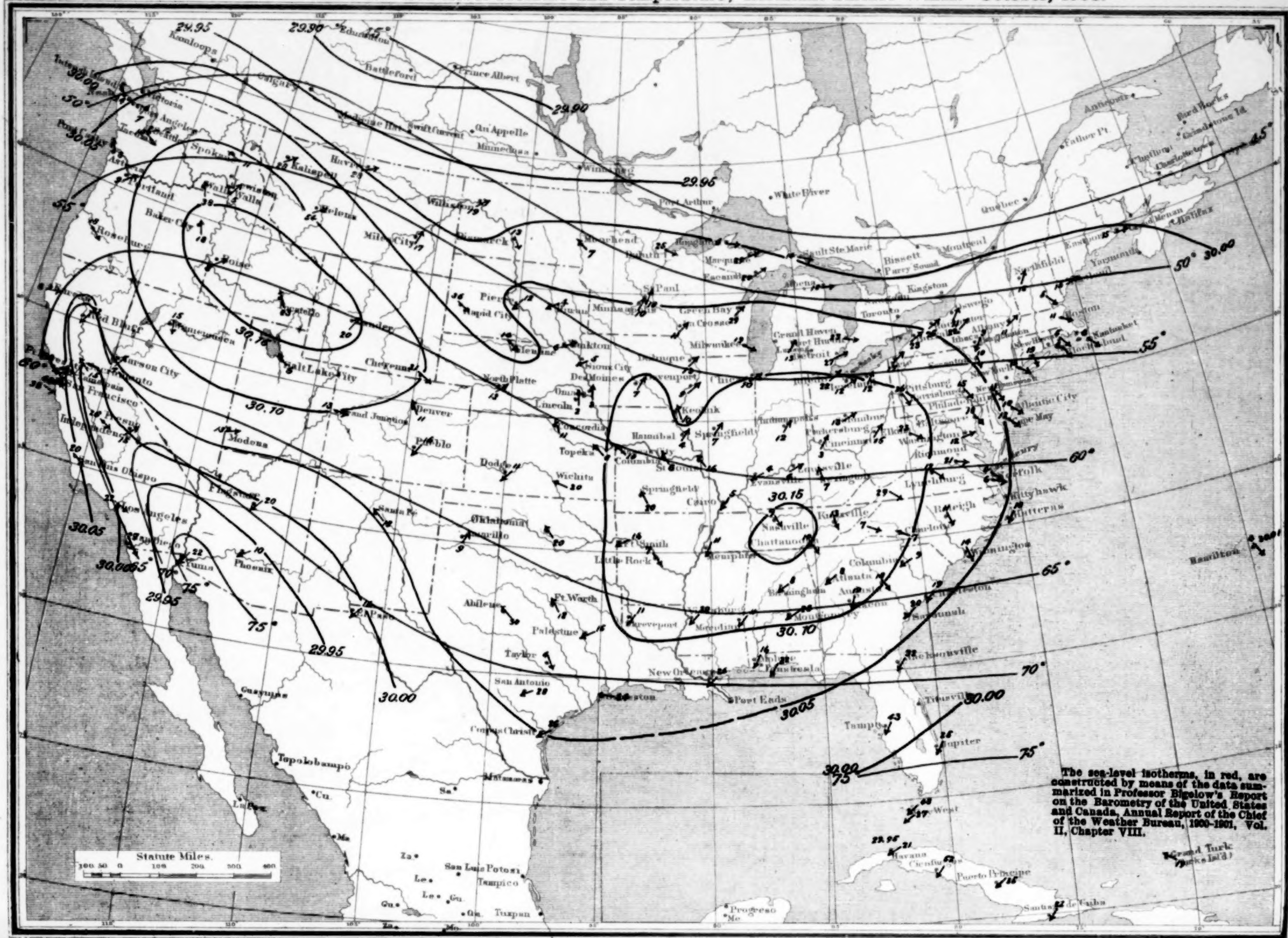

Chart V. Hydrographs for Seven Principal Rivers of the United States. October, 1903.

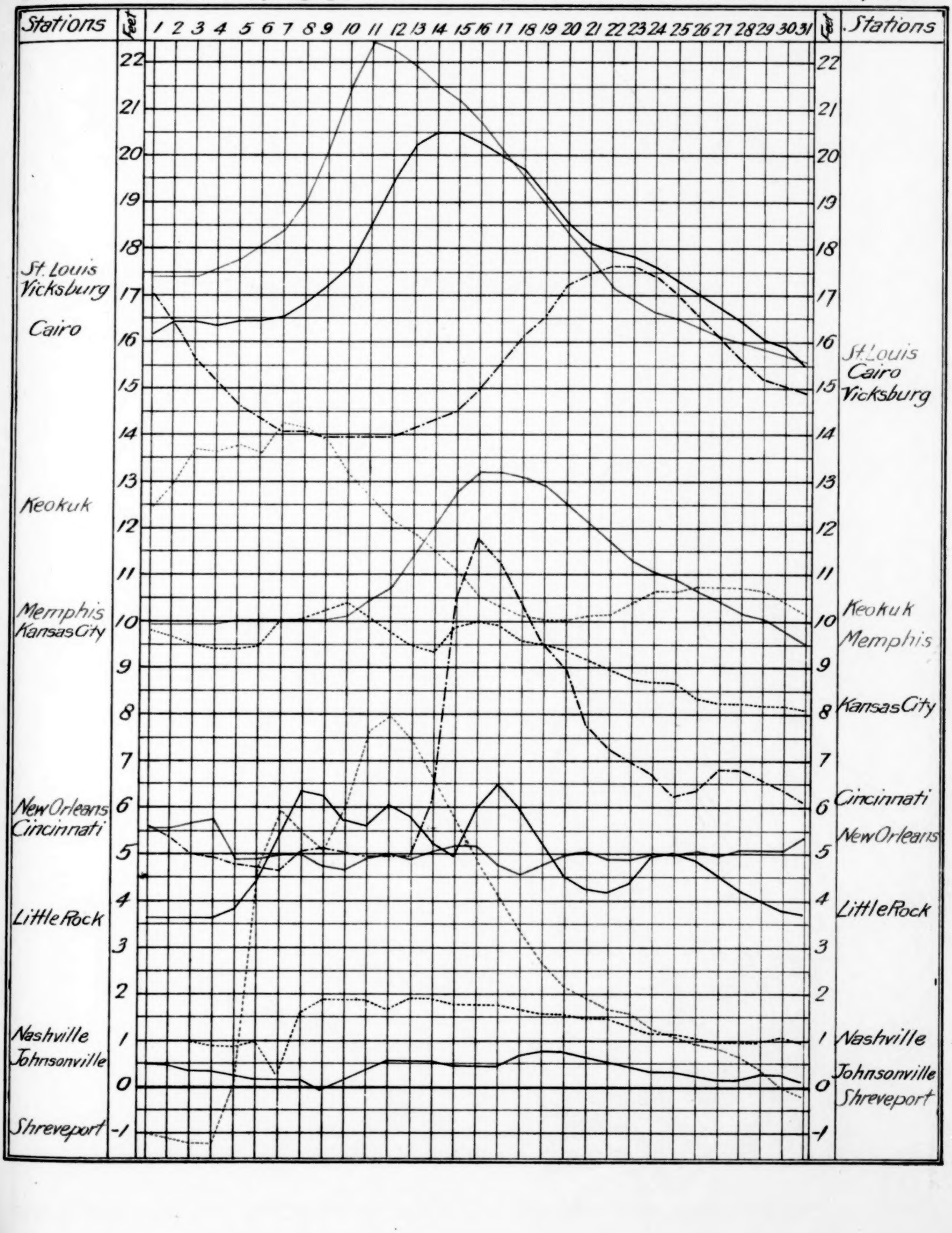

Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. October, 1903.

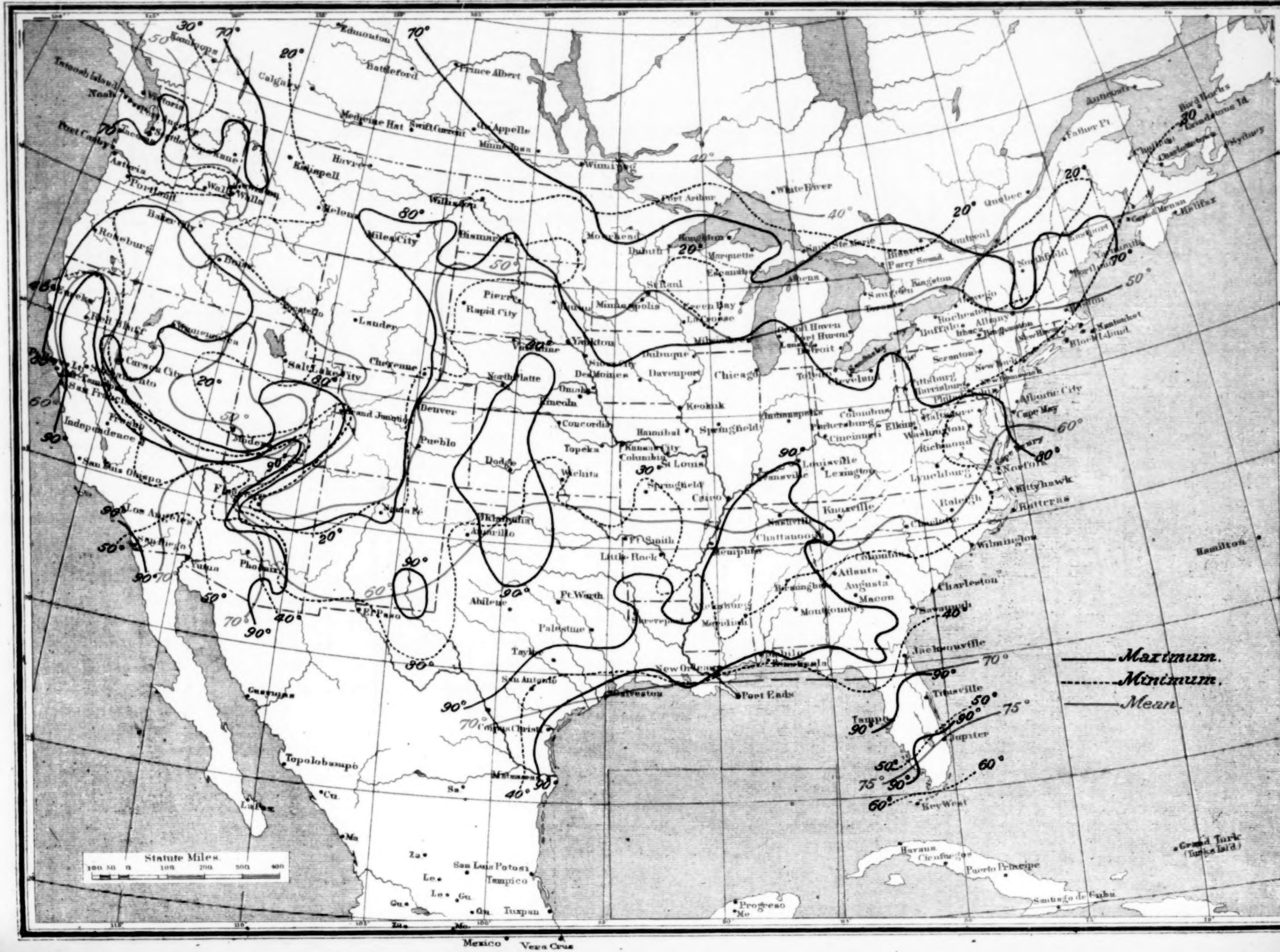

Chart VII. Percentage of Sunshine. October, 1903.

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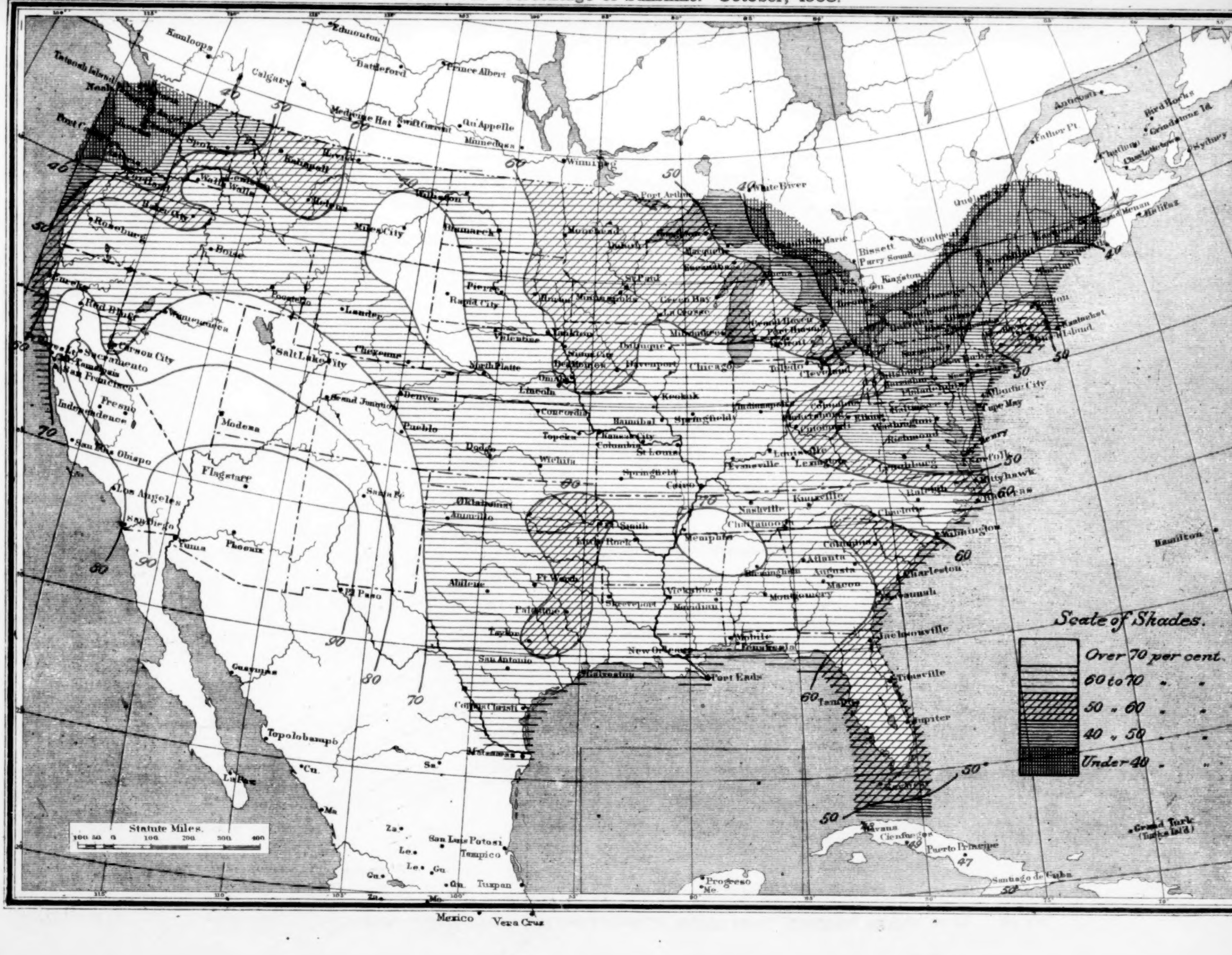

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Chart VIII. Isobars and Isotherms at 10,000 feet. October, 1903.

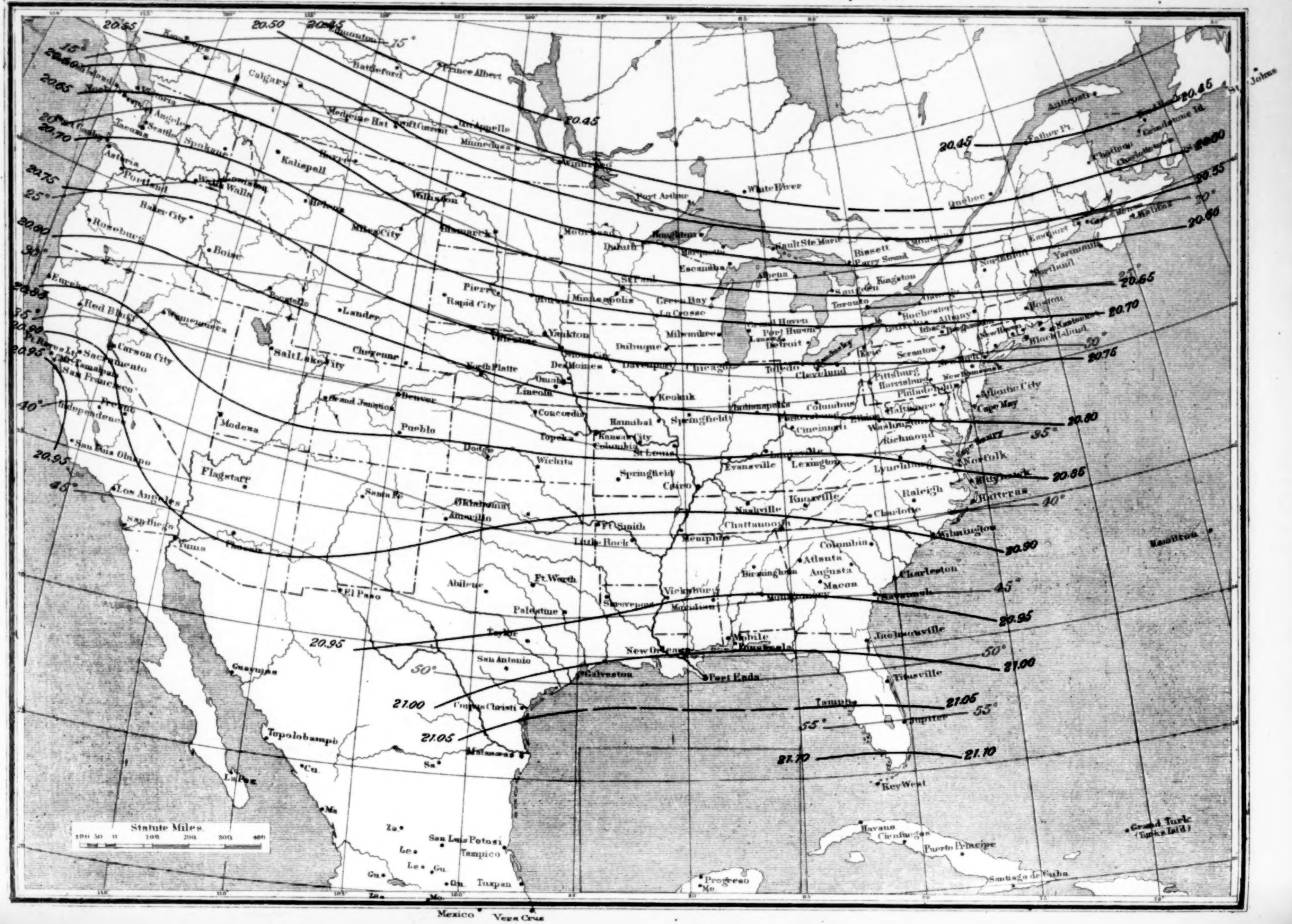

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Chart IX. Isobars and Isotherms at 3,500 feet. October, 1903.

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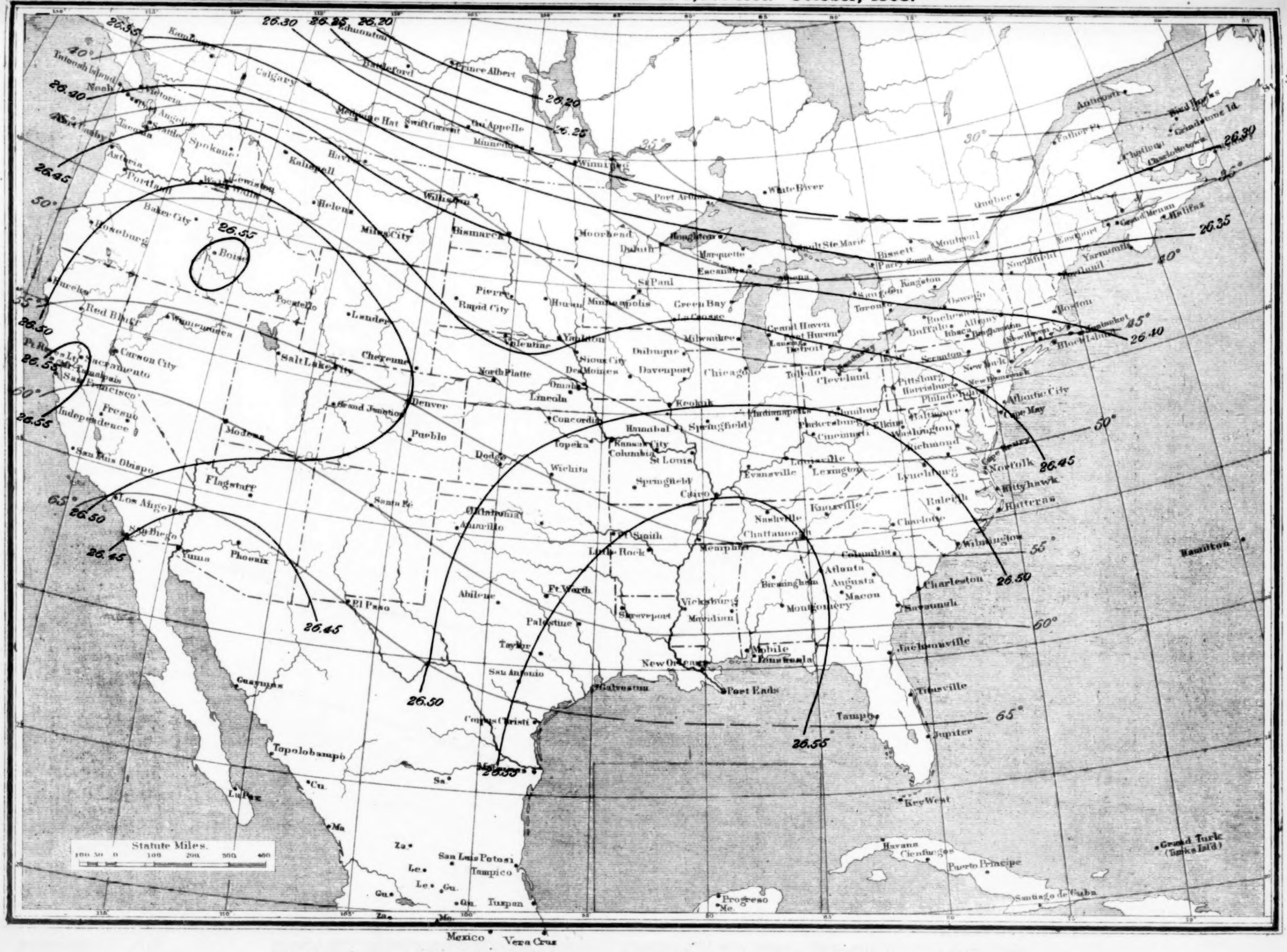

Chart X. West Indian Monthly Isobars, Isotherms, and Resultant Winds, October, 1903.

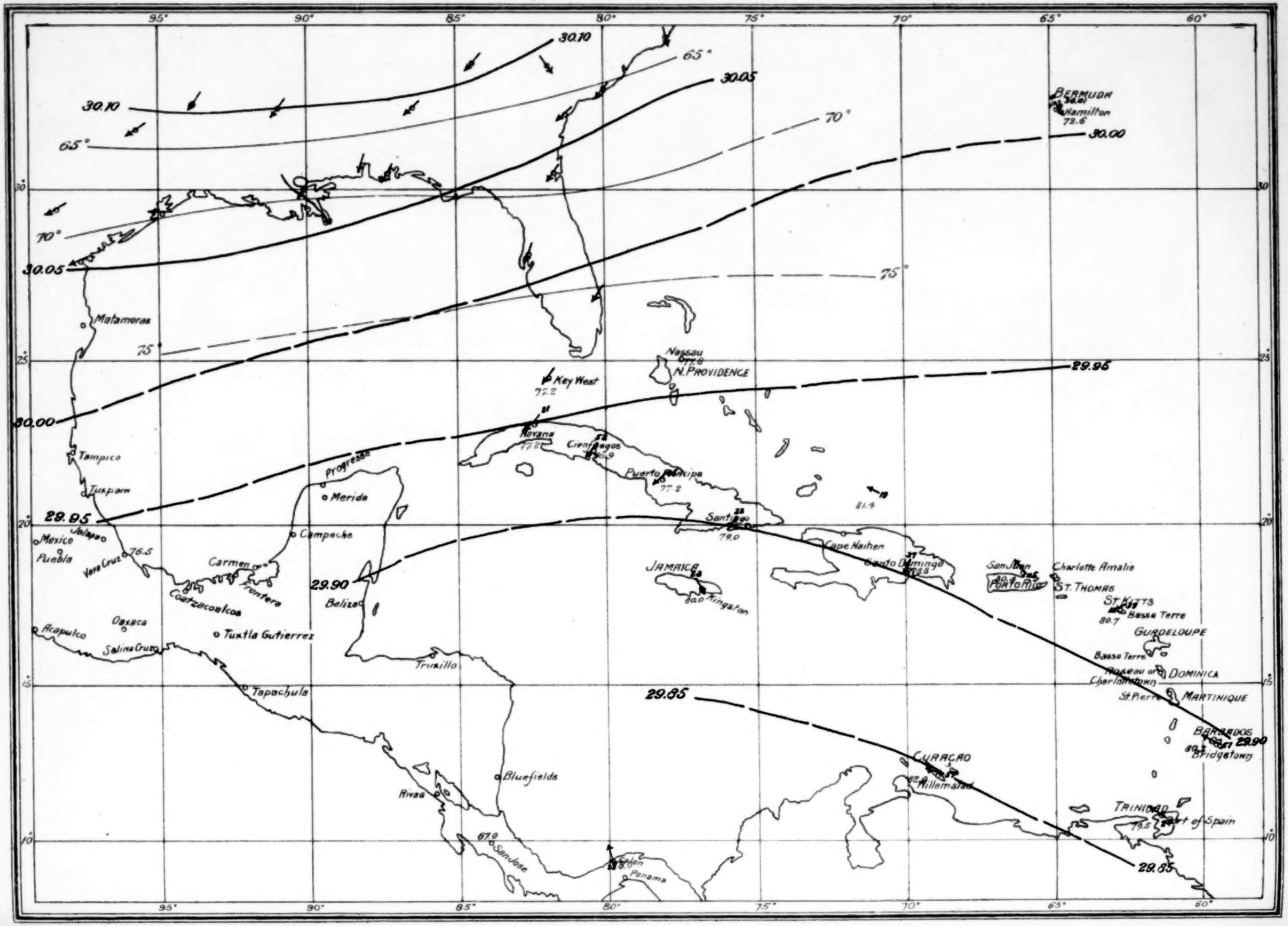

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Chart XI. Total Snowfall for October, 1903.

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